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SACRAMENTO RIVER SALMON FISHERY

By G. H. CLARK

One often hears of the salmon that "used to be" in the rivers of California. The old timers are full of such stories as the salmon being so numerous in the streams on their spawning migrations that one could easily walk across the stream on their backs. Even after allowing for exaggeration, it is evident that salmon were extremely abundant in past years. One hears constant complaints on every side about present scarcity of salmon, with numerous reasons for this condition and many

suggested theories for its remedy. All these suggestions are in good faith. Some of them may be the thing that is needed, but it must be proved before the rest of the "theory makers" are satisfied.

However, before advancing theories, let us look into the past and see what has gone on in this salmon fishery. Suppose the Sacramento and San Joaquin river systems are used as a historical background, as they were the first rivers to be fished for salmon by white men. Salmon first became a commercial product on the lower river, where it empties into San Francisco Bay.

Before this country was inhabited by white men, the Indians came each year to the banks of the rivers and speared and captured their winter's supply of fish. Their catch may have seemed large to them, but was in all probability nothing compared to later catches. Shortly after gold was discovered in California, there was a great influx of white men. The salmon fishery as a commercial industry was established. Dates are not certain, but it is known that about 1850 the industry was well established.

The number of fish taken is impossible to determine. In an article written in 1860, appearing in Harper's *California Magazine*, the author states that in 1852, 337,500 pounds of salmon were used by the local markets during the season. At that time, the author says, the salmon were decreasing. He compares the abundance of fish in 1852 with 1849, saying that in 1849 any amount of fish could be secured with a spear and now [1855-1860] it was becoming hard to get salmon [evidently by spearing]. Gill nets of shoe tread, 150 to 300 fathoms long, were used. A whitehall boat with two men and a single net could catch as many as 300 fish with a drift of a mile in the lower river. Rio Vista was the main fishing center during the early period.

In 1864 the first salmon cannery was started on the Pacific coast by G. W. and William Hume and A. S. Hapgood. It was at Washington, Yolo County, on the Sacramento River. Their methods of canning were crude, of course, as every operation had to be done by hand. Nevertheless, quantities of salmon were canned and, because of the success of the first cannery, numerous other canneries sprang up until in 1881 there were twenty canneries operating on the Sacramento River and in the San Francisco Bay region. These canneries produced, in 1881, 181,000 cases of salmon, and, in 1882, 200,000 cases, as contrasted with the first cannery, which produced 2000 cases in 1864. The canning industry was no bed of roses in those days. The canneries could not afford to pay the fishermen the high prices that the fresh markets could; consequently, the canning companies got a poorer grade of fish and the overflow, after the fresh markets were supplied. After 1882, canning salmon on the Sacramento River declined until in 1919 only 3125 cases were produced, with two canneries operating. Canning was discontinued after 1919.

Canning of salmon was but a small part of the industry, as will be seen by the accompanying graph. In 1880, when canning was at its height, the total poundage of salmon caught in the Sacramento and San Joaquin river regions was over ten million pounds, live weight. Statistical data are meager and not wholly reliable from these early periods,* but the sources of these data were the same and so afford a

* Data on the catch were obtained from the fish dealers and canneries where the fishermen sold their fish.

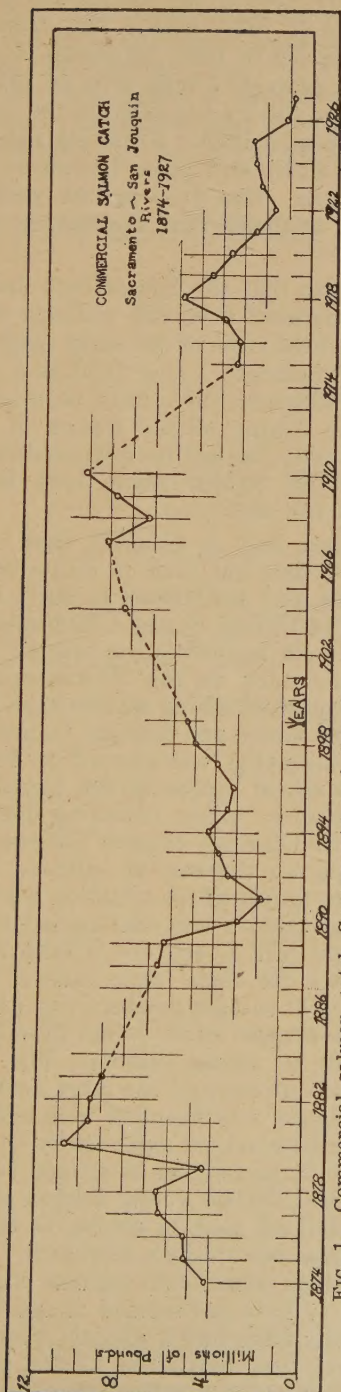


FIG. 1. Commercial salmon catch Sacramento and San Joaquin rivers, 1874-1927. Dots indicate incomplete data.

comparison of the years, even if the figures are incorrect. The graph of the catch from 1874 to 1927, with a few years missing, shows the sudden climb of the fishery to 1880, its slump to a low point in 1891, then its gradual climb again to a high level in 1910 of over 10,000,000 pounds. From 1910 the fishery has been on the downward trend, with a slight rising in 1918 and 1925. From all indications (considering catch records, fishing effort and price increases), the fishery is in a state of serious depletion. The drop in late years is not sudden but gradual, giving every evidence that the fishery is nearing the home stretch to extinction.

Do many of us realize that the Sacramento and San Joaquin river salmon fishery has produced over 205 millions of pounds of salmon since 1874, and in this total some of the early catch figures are missing? What has it produced before? Using 1850 as a starting point of the salmon industry in California, there have been seventy-seven years of more or less intensive fishing of the waters in question. Is it not remarkable that the fishery has not been worked out years ago? These two rivers, until the last fifteen years, have been able to produce immense quantities of fish each year.

Unlike other resources, such as minerals, coal, etc., the salmon could be built up and the resource put back on its former high level. Artificial propagation of fish was established to build up such depleted fish resources. In 1872 the United States Commission of Fish and Fisheries established a salmon egg-collecting station and hatchery on the McCloud River, a tributary to the Sacramento. This station was established for the purpose of taking salmon eggs from the Sacramento, for shipment to eastern states and foreign countries to introduce them into other waters. This policy was carried on for a number of years, until the salmon became so scarce at the egg-collecting station that operations were suspended. After resuming operations in 1888, most of the eggs were hatched for the express purpose of planting them in the river and building up the run of salmon. The egg take at the McCloud station began to fall off, so a station was established on Battle Creek in 1895; another station was constructed on Mill Creek in 1901. Both Battle Creek and Mill Creek are tributaries to the Sacramento River, and were known for their large runs of salmon. These three stations began a period of intense productivity and produced a tremendous amount of salmon eggs which, when hatched, were planted into the creeks and rivers as young salmon. The accompanying graph shows the rise of these stations and the large amount of eggs produced. A state hatchery at Sisson was supplied with eggs from these stations, where the salmon were hatched out and planted in the Little Sacramento River. In spite of the large number of salmon being planted each year in the river (nearly 100,000,000 young salmon were planted in 1906), the catch after 1910 fell off, and, of course, as the catch has fallen off, so has the egg take from the stations decreased. One would think that from such large plantings tremendous returns might be expected. Such expectations did not, or have not seemed to, materialize. Other causes of depletion which may have had a distinct bearing on the fishery are the destruction of the young and adult salmon by pollution, predatory fishes, and the large number of overflow basins in the valley. However, the damage done by these causes is hard to estimate. It is known that

pollution from the drainage of rice fields does cause the death of some salmon. It is also known that some of the fishes of the river prey on the small salmon fry and consume them in numbers, notably the minnow *Ptychocheilus grandis* (Sacramento pike). Until by-passes were constructed through the overflow basins, a large number of young salmon were trapped each year in these lakes and there perished. That condition has now been remedied by the by-passes enabling the salmon to again reach the river.

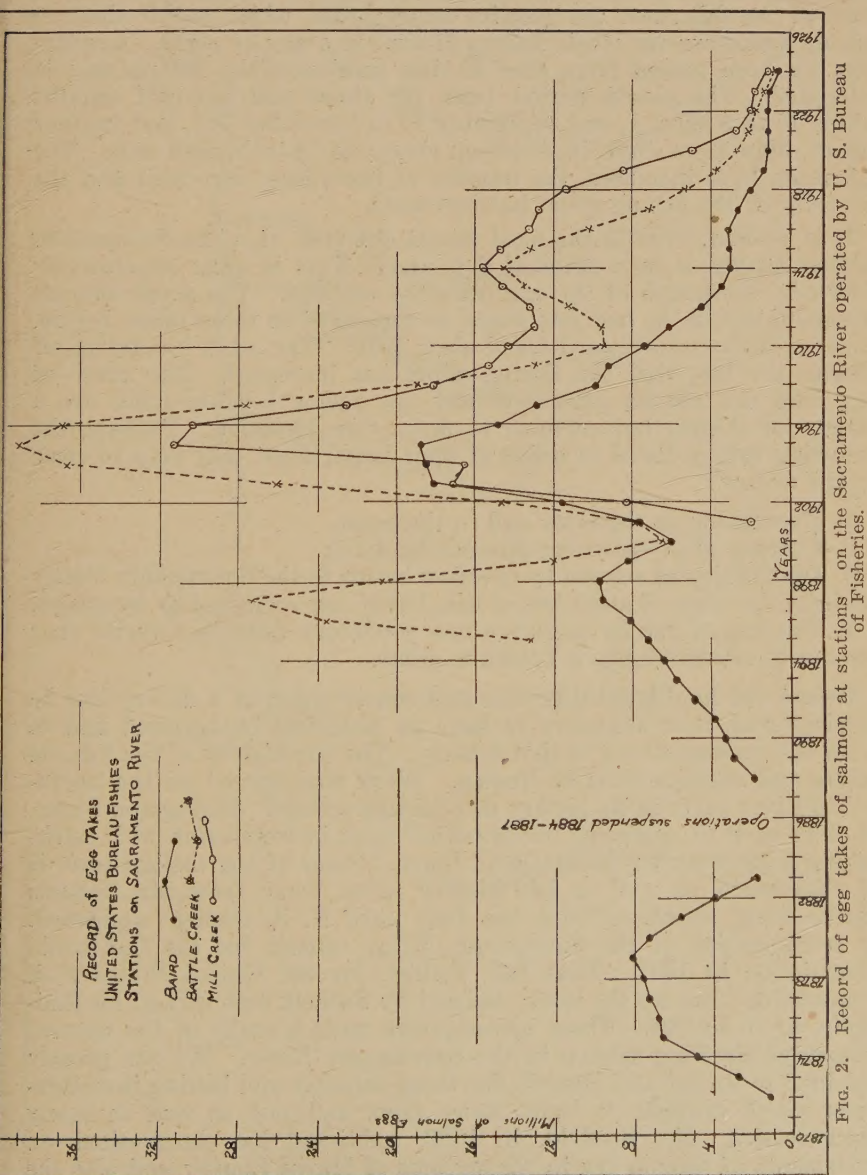


FIG. 2. Record of egg takes of salmon at stations on the Sacramento River operated by U. S. Bureau of Fisheries.

Fishing methods and gear have changed somewhat since the early years of the fishery. In the early days gill nets and seines were used on the rivers. The fishermen used sail boats and row boats. Their range was somewhat limited for each day's fishing, although the fishermen followed the run of salmon up the river in scows in which their families were housed. Legislation had not closed part of their fishing time until 1880, when the season was closed for the month of August and on Saturdays. Since 1924, when seines were prohibited, there has been no change in the gear. The mesh of the nets is restricted in length. Most of the fishermen use gasoline motor boats, which enable them to run up and down the whole fishing district in a day or night. Legislation has been passed from time to time until now the fishing area is restricted. The closed period lasts for three and one-half months (June 15 to August 1, and September 17 to November 14), and another month, May 15 to June 16, is closed except to 7½-inch mesh nets. The fishermen have increased, the number of boats have increased and the intensity of the fishing effort has increased.

It is evident, even to the most casual observer, that the Sacramento salmon fishery is in a state of depletion. This is quite conclusively shown by the graph of the egg takes, by stations. The small amount of eggs taken in the last few years, as compared to those taken before, shows a distinct downward trend since 1910. The catch has fallen off despite the fact that the fishing effort has increased. The cause of depletion can not be pinned to any one factor because there are a variety of things that combine to make this depletion. Perhaps the following causes, listed in order of their importance, may help to clear up the matter:

1. Overfishing in the river and in the ocean.
2. Cutting off of spawning grounds by dams.
3. Destruction of salmon by overflow basins in the Sacramento Valley has been the cause of great loss of fish, but is now remedied by by-passes.
4. The loss of fish by pollution and predatory fishes is a factor that can not be estimated but is known to occur.

Before the intelligent direction and conservation of a fishery can be administered, it is necessary to have an historical background and to know the present status of that fishery. The life history of the fish, its habits and enemies must be known. Work was started on the Sacramento River early in its history as a salmon stream. Livingston Stone, as early as 1872, did some investigation work in connection with establishing a hatchery on the McCloud River. Some of our earliest records of abundance, as well as life history notes, come from Mr. Stone's observations. Nothing more was done until N. B. Scofield undertook an investigation of the Sacramento River salmon for the California Commission in 1897. That fall, Rutter, for the United States Fish Commission, took up the work, assisted by Scofield who turned his findings over to Rutter. These investigators made a study of the natural history of the king salmon in the Sacramento River. We are greatly indebted to Rutter and Scofield for these valuable and lasting investigations which brought to light many facts and put an end to many controversies. Mr. Scofield, in 1900, published his observations on movements of salmon fry in the streams of Marin County and also the seaward migration of young in the Sacramento River.

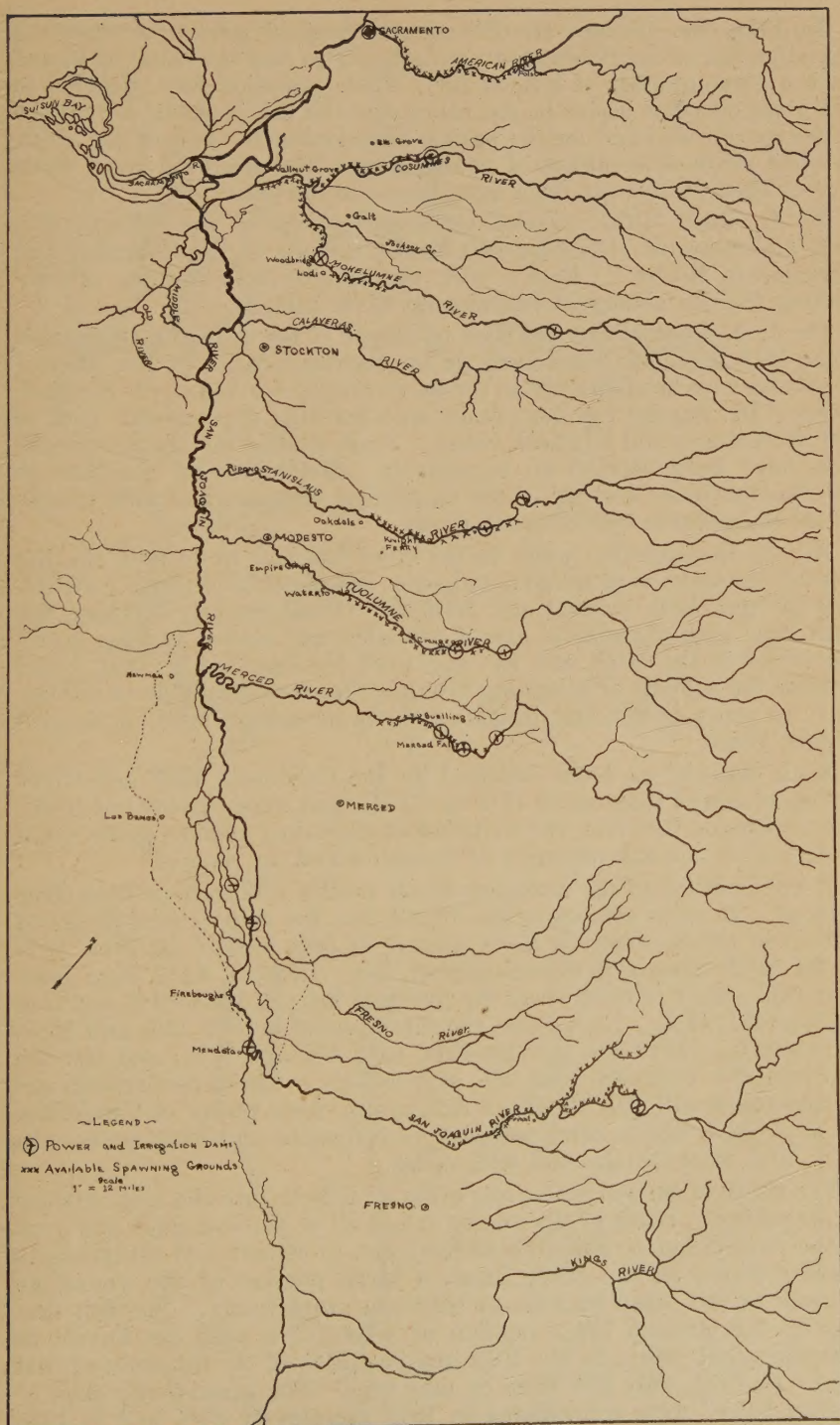


FIG. 3. Map of the San Joaquin River, showing power and irrigation dams and available spawning grounds for salmon.

In 1911, Dr. Charles H. Gilbert and Scofield started to make an investigation of the Sacramento, principally to find the cause of loss of such a great number of salmon fry. Their attention was attracted to the great overflow basins in the valley and the fish in them, so that the investigation centered on the basins, abandoning the rest of the river. Scofield made observations of young salmon and steelhead trout while towing them in live car from Sacramento to the sea.

W. H. Rich (1920) carried on investigations of the "Early History and Seaward Migration of Chinook Salmon in the Columbia and Sacramento Rivers." Rich's work was another step upward in completing the life history of Sacramento River salmon.

Dr. J. O. Snyder, who has been in charge of the salmon investigation since 1918, has done some work on the Sacramento River, but most of his efforts have been directed to the ocean-caught fish and to the Klamath River. Dr. Snyder has done much with marking experiments, both in the Sacramento and Klamath rivers. Scale studies for age determination have been carried on extensively. McGregor, an assistant to Dr. Snyder, made a study of the anatomical characters of king salmon of the Sacramento and Klamath rivers.

All the investigation work on the river has had to do with the life history, movements of salmon, and some experimentation with fertilization of eggs, both natural and artificial. Until recently, nothing has been done with abundance, age of maturity, age classes and sex representations in the catch, nor has any work been carried on that would disclose the amount of spawning grounds that were available to salmon, since so many power and irrigation dams have been built in the last twenty years.

With material on hand collected by the California Fish and Game Commission at Pittsburg in 1919 and 1921, and some material of previous workers on the river, the writer has undertaken a study of the scales to determine age and maturity of the salmon of the river.

A brief outline of the more important results will perhaps have some interest. In these studies it was found that the greater percentage of salmon in the Sacramento River mature at four years. In 1919, 49% of the catch examined were four-year fish. In 1921, 44% were four-year fish. Next in order were the five-year fish; in 1919, 24% matured and in 1921, 41%. Next comes the three-year-olds with 22% and 12%, respectively. Then the six-year-olds, with 4% and .7%; and last the two-year fish with .2% and 2%, respectively. These percentages are in agreement with Dr. Snyder's findings in other places in California. In 1919, 68% of the catch samples were females and 32% males. In 1921, 70% were females and 30% males.

The study of salmon scales also gives an insight into the early history of the salmon. Some of the salmon spend all or more of their first year in the stream, before going on to the ocean to mature and returning to spawn; while, on the other hand, a large portion of the young go directly to the ocean as soon as they can swim freely. The fish that stay in the streams for a portion or whole of a year are known as "stream type" fish. In the 1919 samples, 13% of the fish were of that type. In 1921, only 9% were of that type. The ocean-going class or "ocean type" were represented in 1919 samples by 87% and in 1921 by 91%.

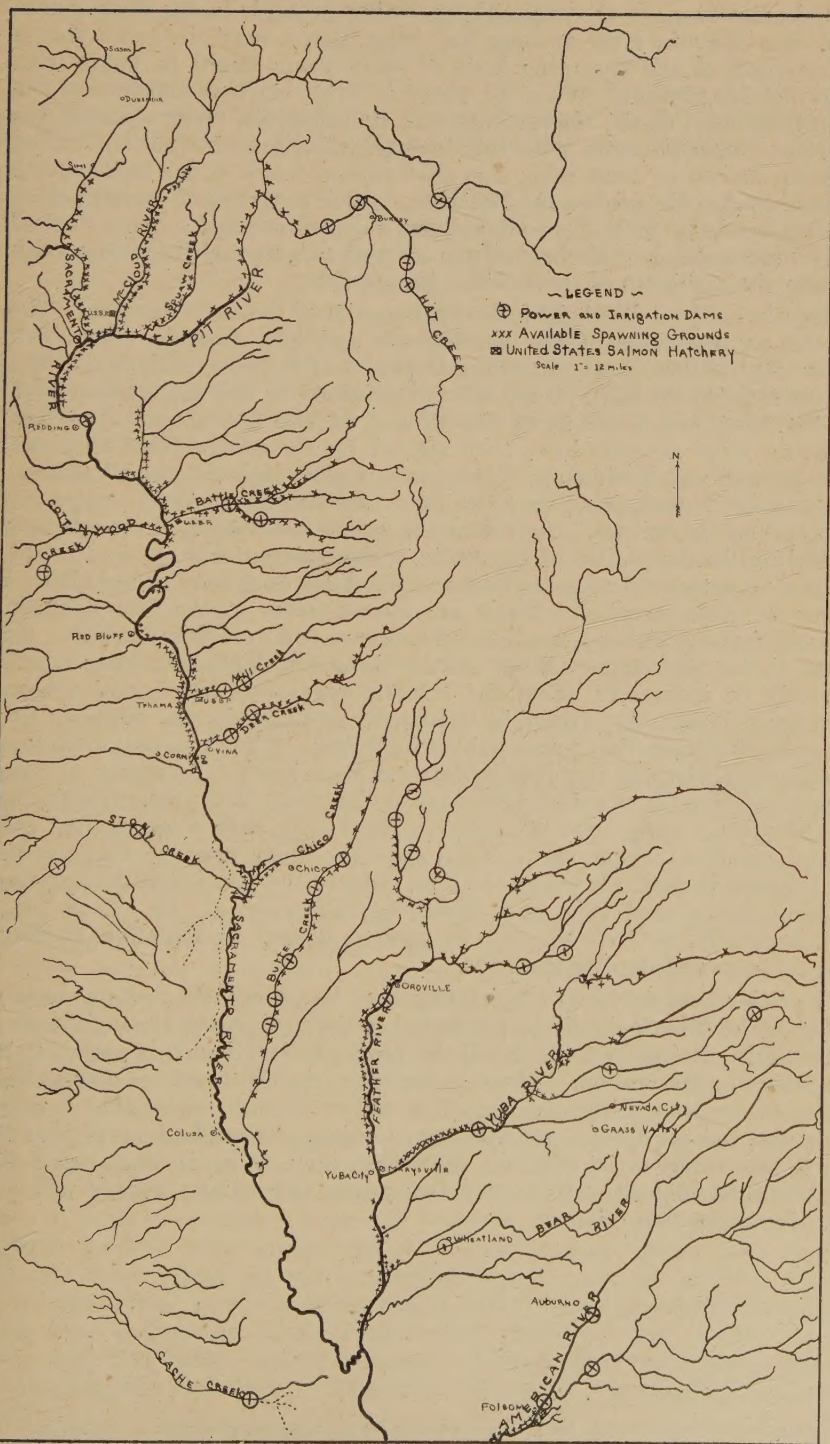


FIG. 4. Map of the Sacramento River above the city of Sacramento, showing power and irrigation dams and available spawning grounds for salmon.

Information as to the available spawning grounds in the Sacramento and San Joaquin river systems had long been a need, in order that a comparison of the spawning beds of early years might be made with those of the present. With the above in view, an investigation of the spawning beds of the Sacramento and San Joaquin river systems was started. In connection with this investigation, the obstructions in the streams had to be dealt with, also observations made of fish ladders and screens and their success in operation. Such a survey or investigation as this has been difficult to pursue and has necessitated a great deal of traveling and personal observation, as well as personal interview work among the residents of the sections in question.

Herein are presented the important results of the investigation. The accompanying maps of the Sacramento and San Joaquin rivers will show the location of the spawning beds and of the obstructions that are a detriment to the fish. It has been determined by this survey that 80% of the spawning grounds of the salmon in the Sacramento and San Joaquin river systems have been cut off by the obstructions of dams, both power and irrigation. Dams as an obstruction to adult salmon are not as important as they are as a destructive agent to the young descending the stream. As near as it can be calculated, there are now (1928) 510 lineal miles of stream in which salmon may, and some do, spawn, as compared to an estimated 6000 miles of spawning beds before dams were constructed. There are eleven dams in the San Joaquin system that are either a hindrance to salmon or a complete barrier. Of those in the Sacramento River system there are thirty-five dams which directly or indirectly affect the salmon migration. It has also been determined that the available spawning grounds do not support the amount of salmon they are capable of holding. The explanation of this fact is that when an impassable dam has been built in a stream, and no means provided to get the adults over or the young back, the run usually perishes, or a great part of it does. Each year they come against the same obstacles. Some survive and spawn. Their progeny will return and spawn in grounds below the dam; but in the process of getting the salmon accustomed to a new spawning bed, most of the run is lost. Consequently, we have the dam as another agency in depletion, as they cut off beds and deplete the runs.

In order that protective legislation may be passed, the facts as to the state of the fishery should be presented to the people and the legislature. A bulletin, giving in more detail the facts presented in this paper, it is hoped will appear soon. The salmon fishery in California is now at the point where something must be done and at once, in order that it may be preserved for future generations to enjoy. It might be said that it must be conserved so that we, ourselves, may enjoy it while we live. Unless it is conserved in a very few years, the salmon fishery will be nothing more than history.

WILD DUCK DISEASE*

By HENRY VAN ROEKEL

An investigation on the duck disease this year has been started by the Fish and Game Laboratory at George Williams Hooper Foundation for Medical Research, University of California, San Francisco, California.

It is reported that the duck disease has been observed for the last twenty years. Apparently from the information at hand the malady confines itself to shallow water areas, and the fall of the year. According to recent information, losses among waterfowl, largely ducks, have occurred this year in Arizona, California and Idaho. Since clinical studies and autopsy findings are missing, it is impossible to state whether all these losses are due to the same cause. The telluric and aquatic conditions and the general descriptions given by those who have seen sick birds are quite similar in the places in which the disease has been extensively studied.

In California, during the past year, the disease has been observed at Tule Lake (Modoc County) the first week in September. The water in this lake is very shallow, and at places the mud bottom rises above the water. During the dry summer months very little water flows into the lake. A greater part of its basin has been reclaimed and cultivated. Part of the lake was surveyed as to the number of apparently normal and sick birds. Sick birds were collected on the water, some were autopsied immediately and others were taken to the laboratory for further observation and examination.

During the second week of September the duck disease appeared at the duck clubs near Delano, California. Here the conditions were not identical with those at Tule Lake. The duck ponds were adjoining the old Tulare Lake bed. The country is very level, with clay-like soil and little vegetation. The water supply comes from nearby wells. The water change in the ponds was slow and the depth about eighteen to twenty-four inches. Although the telluric conditions differed in many ways, the findings made thus far revealed no difference between the sick birds from the two affected areas.

Many opinions have been advanced as to the cause of the duck disease; unfortunately they are based on casual observations and incomplete investigations. Some observers have propounded the theory that the disease may be prevented by avoiding shallow and stagnant bodies of water for wildfowl. This may or may not be the solution in the end. With no proof for this, and meager experimental evidence, the important problem suggests a thorough and systematic investigation as to the nature and source of the cause. With this in mind a scientific program of field and laboratory experiments has been outlined and the work to execute it is now in progress.

Field studies were conducted at the Hollywood Duck Club near Delano. The nature of the experiments were such as to determine where the cause of the trouble might exist. Two screened enclosed pens, each containing thirty birds, were placed on the ponds. The birds were fed barley and milo-maize. Thirty birds were also placed in an enclosure on land. These were fed pond water and no fresh

* The research staff expresses its sincere appreciation for the cooperation received from gun clubs, the patrol force and others in this investigation.

water. Since no normal wild ducks were available at the time, it was necessary to employ ducks which had recently recovered from the sickness. Body temperatures and recovery records on sick birds were taken. The field work covered a period of six weeks. No definite conclusions can be deducted from the results at this time, since the microscopic study of the collected pathological specimens has not been completed.

Reports have been received that the disease had ended at Tule Lake about the latter part of October. At the duck clubs few sick ducks were found after the first rain on November 11 and 12. Weather changes, such as rains and decrease in temperature, apparently had a marked influence in arresting the malady.



FIG. 5. An experimental pen of ducks on the Hollywood Duck Pond. Hollywood Gun Club, Kern County, California, 1928. Photograph by E. S. Cheney.

The investigation will be continued through laboratory experiments on trapped normal ducks. It is hoped that the results will either prove or disprove certain phases of the duck disease. The progress of this work is greatly retarded because it is very difficult to duplicate natural conditions at the laboratory. Hence, any results that may be obtained by laboratory experiments will have to be repeated under natural field conditions as soon as the disease reappears in California.

It is needless to emphasize that the conservation of the waterfowl is markedly affected by the duck disease. At the present time relatively few suitable nesting and loafing areas absolutely free from the malady can be found in California. More water areas are being taken away from the birds each year by agricultural and industrial enterprises. A committee on game refuges has been appointed to correct, if possible, such conditions as exist in order to assure a safe and suitable refuge for waterfowl. However, little progress can be made until the origin and nature of the duck disease has been established.

THE STATUS OF SALMON IN CALIFORNIA

By N. B. SCOFIELD.

Are We Going to Save the Sacramento River Salmon?

While our fisheries as a whole are in a healthy condition, it can not be said that our oldest fishery, that of the salmon, shares this condition. The most important conservation problem having to do with fish or game in this state is that of saving what is left of the salmon.

We have repeatedly called attention to the fact that the salmon of the Sacramento River are not being given sufficient protection and that this valuable natural resource of the state is fast being destroyed. The legislature has been told that if these salmon are not given more protection they will soon become commercially extinct. We have pointed out that the run on the river is only 5 per cent of what it was twenty years ago; that the hatcheries on the river can not obtain enough eggs with which to run them at even 10 per cent of their capacity. At each session of the legislature for the past twelve years, the Fish and Game Commission has sponsored bills which would have given these fish at least a measure of the protection needed, but in no instance was it possible to get more than a very small portion of the protection asked for.

At the last session the Commission was sponsor for a bill which would have eliminated sea trolling for salmon. It was pointed out that the salmon supply had been so diminished that to fish for them, both in the sea and the river, was fast destroying the supply, and to save the remnant that was left, one or the other method of fishing should be stopped. As the river fishing has more to commend it than the sea trolling, we proposed that trolling be stopped.

The measures embodied in this bill were indorsed by the Associated Sportsmen's Clubs and included a prohibition of all salmon spearing. For a number of years salmon spearing had been stopped in all but the extreme northern half of the state. When the several salmon bills came up for consideration before the Assembly Fish and Game Committee this bill was not given a hearing and it had to give way to a bill sponsored by San Joaquin Valley sportsmen's clubs, member clubs of the state organization but whose only desire was to have the law changed so as to permit salmon spearing in their part of the state. Instead of advancing, we took a step backward. The committee consented to amendments for the purpose of confining spearing to a season when the salmon are in good condition to eat, and thus prevent the killing and discarding of fish which are not fit to eat although they may be of the greatest value for the purpose of reproducing the race. The committee also accepted amendments to prevent the spearing or killing of salmon on spawning beds, but it would not accept an amendment which, as a compromise, would have stopped sea trolling for salmon south of Mendocino County.

Due to the confusion caused by numerous changes in the bill as it progressed through the two houses and the two committees, in an effort to get spearing and angling seasons to suit the various desires of sportsmen in the different parts of the state, a number of errors entered into the bill. As a whole, the salmon law is now quite unsatisfactory in that it does not suit the sportsmen anglers and does not give more than

* This article appears in the Thirtieth Biennial Report, Division of Fish and Game, pp. 112-117.

a small part of the protection from commercial fishing which is needed if we are to save the Sacramento salmon from commercial extinction. When this salmon bill came up before the Senate Fish and Game Committee a very strong effort was made by Sacramento commercial fishermen to have the fall season extended to permit them to catch more fish on the claim that the salmon are running later than a few years ago. The fishermen are honest in their conviction that the run on the river is getting later, but what appears to be a lagging of the run is not real but is due to serious depletion of the supply, during which the fish have become so scarce that it does not pay the fishermen to fish until a later time in the running season than formerly, when the fish were more plentiful. This is a well known phenomenon to fisheries investigators. See our article, "Is the Salmon Run Becoming Later on the Sacramento River?" The committee listened to our plea and refused to extend the season.

Commercial fishing on the Sacramento and San Joaquin rivers must not be entirely blamed for the present scarcity of salmon on these rivers. In the past years the fall season for commercial salmon fishing on these rivers has been extended at two or three different times to a later date on the claims of the fishermen that the fish were running later. It was not recognized at the time that what appeared to be a gradual retarding of the run was the effect of serious overfishing. Four years ago we were able to get the closing date of the season put back from September 25 to September 17. That date is not early enough. It should be not later than September 7. There are other causes which explain the growing scarcity of salmon on the Sacramento River. The chief cause is the building of power and irrigation dams which can not be surmounted by salmon. It is estimated that fully 75 per cent of the former area of suitable spawning beds have been shut off from the salmon. The silt from placer mining ruined most of the Sierra streams for salmon. Unscreened irrigation ditches have in the past taken a large toll from the young salmon migrating to the sea and this loss has not yet been entirely stopped. As the reproduction of the salmon was cut down by these factors the commercial catch on the river should have been cut down in proportion. But it was not. Then later the sea trolling for salmon grew to be important, being first developed at Monterey and later outside San Francisco harbor. The troll catch of some years exceeded five million pounds on Monterey Bay and that, coupled with the catch off San Francisco, equaled, roughly, the catch on the Sacramento River. Due to this large troll catch, which was largely made up of Sacramento salmon, the total catch on the river was greatly reduced. If this great added drain on the Sacramento salmon supply by troll fishing was to be permitted, the fishing seasons on the river should have been cut so as to compensate for it, but this was not done—just as in the same way nothing much had been done in the way of curtailing the river catch to compensate for the damage done by dams, placer mining and screenless irrigation ditches.

The troll catch in Monterey Bay is now only about ten per cent of what it was a few years ago. The number of salmon escaping the nets and reaching the spawning grounds, as evidenced by the number of eggs the Sacramento spawn-taking stations are able to take, is only 5 per cent of what it was twenty years ago. The total catch of salmon, including the Sacramento River and the troll catch in the sea from

Monterey to Mendocino, is less than one-third of what it was ten years ago. All of this is sufficient evidence to convince the most skeptical that we have only a remnant of our former salmon supply left, and that nothing short of drastic measures will save the small remnant that remains.

Is the Salmon Run Becoming Later on the Sacramento River?

It is generally believed by fishermen that the salmon run on the Sacramento River is becoming later and that for that reason the open commercial season for netting should be extended to a later date. They believe that when the season now closes, on September 17, the run is just getting good or that the best part of the run has not yet arrived. The run does have the appearance of becoming later, but in fact it is not later. The appearance of being later is due to the serious depletion of the river's salmon population, as I will attempt to show.

This appearance of a retarded run is a phenomenon which is not peculiar to the Sacramento River alone. It has been observed on other salmon streams in this country and on some of the salmon streams of Scotland. There may be two runs of salmon on a stream, as on the Sacramento, a summer and a fall run. These two runs are made up of the same salmon species. The summer run is always the smaller and is made up of individuals which come in earlier than the main run. On a stream with two runs, the fishing is poorest during the summer run because there are fewer fish in the river then. This summer run may be so light that it does not pay the commercial fishermen to fish. As the supply of salmon in the streams is depleted, the summer run is the first to be reduced to a point where fishing does not pay. It is a well known fact that this summer run is the first to show the effects of overfishing. Salmon streams in Scotland are called "early rivers" and "late rivers," the early rivers being those with spring and fall runs, the late rivers those without the spring run. W. L. Calderwood, the Scottish authority on salmon, has the following to say about the effects of overfishing.

After speaking of the reappearance of spring fish in a stream which has been given protection against pollution and overfishing, he proceeds:

"In other cases where serious overfishing has been allowed to continue, rivers have naturally acquired a late character. With overfishing, or other causes of reduction of breeding stock, the first class of fish to disappear is the spring run."

Overfishing, pollution of the stream by factory waste or destruction of spawning beds by the erection of impossible dams affect both the early and late runs, but the early run, being the smaller, is the first to reach the low point where it does not pay to fish. As this summer run begins to fail, some of the fishermen do not fish until the later fall season, and the belief arises that the salmon run later.

We have this same appearance of the run becoming later in the fall run itself. The runs do not come into the rivers suddenly. A run starts by a few fish arriving, and the run gradually grows in proportions over a period of several weeks or months until the peak is reached. After the peak is reached, the run quickly subsides and is soon over. For this reason, when serious overfishing is taking place, the peak and conclusion of the reduced run will remain fairly constant in time, but the time at which profitable fishing begins during the early stages of

the run comes later and later, as the salmon supply is reduced. This is exactly what is happening on the Sacramento River. The run is not later. The profitable fishing is later but the conclusion of the run is not later.

A number of years ago the Sacramento season closed on September 16. The Fish and Game Commission and the legislature were convinced by the fishermen that the salmon run was growing later and that too large a portion of the run was protected by the closed seasons. Therefore, the open time was extended five days and a few years later again extended to September 25. It was then observed that before September 25 arrived all the salmon had arrived and the last stragglers, or so many of them as were not caught by the nets, were well up the river. The fishermen on the lower salmon fishing grounds found that there were no salmon to catch as the run was over. Therefore, before the season closed, they would move up the river with their nets and the last remnant of the run was subjected to the intensive fishing of the combined commercial forces of the bay and the river. The closed season, theoretically designed to let at least one-third of the run pass up the river unhindered by nets, was not freeing any portion of the run from the destruction of the nets.

It took years of effort to get that closing time back to where it was. In fact, it never has been gotten back to where it was. It closes one day later, on September 17. The season should close one week earlier than it does now, if we are to continue to have a Sacramento commercial salmon fishery. The fishermen are seeking to have the season close again at a later date. The object, of course, is so they can take more salmon. They still use the argument that the run has become later. I hope I have made it clear that where it appears the run is later, that is due to the serious depletion of the salmon supply. What we need is enough protection for our salmon that the run will have the appearance of becoming earlier.

Klamath River Salmon.

It is being claimed, by sportsmen mainly, that the salmon run in the Klamath is being destroyed by the commercial salmon fishery on that river. There is also complaint from the same source that the steelhead run is being destroyed by the nets and it is proposed to close the river to commercial fishing. I do not wholly agree with these charges, nor do I agree that the river should be closed to commercial fishing. As the conditions on the river, in relation to the commercial fishing, are so generally misunderstood, I propose to review briefly the recent history of the fishery on that river.

Prior to 1913 the salmon seasons for the Klamath were the seasons adopted for the Sacramento and did not fit and were not enforced. It was lawful to net steelheads on all of our northern streams, as is still the law on most of the streams of Oregon and Washington. In 1913 the present fall salmon season was adopted and the commercial fishing was confined to a tidewater district extending up the river about six miles. A short open season was also provided during part of the time the spring run of salmon was on; and a few years later, during the war, a season from September 30 to November 1 was opened to permit the taking of silver salmon which enter the river later than the chinook run.

In 1913 there were three salmon canneries on the river. A year or so later the number was reduced to one and that has been the only cannery on the river since, unless we count the two or three small, portable canneries termed "sportsmen's canneries" because they can salmon and steelheads which the sportsmen catch. Under the law of 1913 the chinook salmon run on the river increased, as was evidenced by the increased commercial catch coupled with an increasing egg yield at the Klamathon station many miles up the river, where the eggs were taken from salmon which escaped the nets or passed up during the closed seasons. The fall chinook season closed on September 6, and it was believed that a sufficient portion of the run entered the river after that date to spawn and maintain the supply, even if all the salmon entering the river during the open season should be caught. This belief was later justified by the decided increase in the number of salmon in the river.

At that time, there was no sea trolling for salmon in that part of the state to act as an added drain on the river's salmon supply. The highways were yet so poor that it was not profitable for the San Francisco fresh fish markets to draw on the river's supply of fish. Under these conditions, the fish supply of the river was actually being built up. Later came the development of a salmon troll fishery out of Eureka, whose field of operation gradually extended to the north until the Klamath's salmon were being caught in large numbers off the mouth of the river. The improved roads have not only opened the river up to sportsmen and subjected it to heavy fishing, but they have made it possible for fresh fish markets to send buyers to the river and to truck out the salmon and steelheads. The scarcity of salmon in California, due to the failing runs at Monterey and on the Sacramento, has added to the zest with which they are sought in the Klamath and in the sea outside the mouth. The chinook run in the river has begun to show signs of depletion. I am convinced that sea trolling is the principal cause of this depletion and that the salmon in the river would have held their own if it had not been for the development of the sea trolling off the mouth of the river.

A number of conservation measures have been passed by the legislature for the regulation of commercial fishing on the river. About six years ago the spring salmon open season on the river was done away with. Four years ago the late silver salmon season was taken out of the law, and it was made unlawful to take steelheads in nets or to sell steelheads which have been taken any place in California. At the same time, to prevent steelheads from being taken by the gill nets being used on the lower Klamath River for salmon, the minimum size of the mesh which may be used in the gill nets was raised from $6\frac{1}{2}$ to $7\frac{1}{2}$ inches. As the steelheads running between July 1 and September 6, the present netting season, are small, very few, if any, will be taken by the $7\frac{1}{2}$ -inch gill nets. These measures which have been adopted should allay any fear sportsmen may have had that the steelhead run on the river will be damaged. There is no need to stop commercial fishing on the river as far as steelheads are concerned. As for the salmon, they will get about all the protection they need from the action of the last legislature, which cut off two months of the troll fishing by providing a closed season extending to the first of June. I am referring here only to the

Klamath River and to trolling in the northern coast districts of the state, and do not wish to imply that the salmon are getting necessary protection in the rest of the state, for they are not.

It has been here stated that only 5 per cent as many salmon eggs can be taken now on the Sacramento for the hatcheries as was taken twenty years ago. There has been no such falling off in the number of eggs which are taken on the Klamath. For a number of years, an average of at least seven million young salmon a year have been planted in the Sacramento, which were hatched from eggs taken from the Klamath.

TROUT FISHING IN CALIFORNIA TODAY AND FIFTY YEARS AGO

By WALTER R. WELCH

It is said that "angling differs from fishing in that it is practiced not as a means of obtaining a livelihood but as a source of recreation and refining pleasure. It implies a certain degree of æsthetic culture, coupled with moral and religious susceptibility, and is thus pre-eminently the scholarly gentleman's pastime—the brainworker's diversion.

"The meditative, humane, unselfish nature of the angler is proverbial, his sympathetic disposition, his regard for the rights of others, his moderation in the pursuit of his sport. Angling may, therefore, be appropriately defined as a 'school of virtues,' in which, while the tendency to introspection and self-examination is decided, men learn also lessons of wisdom, resignation, forbearance and love—love for the lower forms of animal life, love for their fellow creatures and love for the God of Nature."

That is why when

"Nature calls and we long to go
Into the woods where the sweet pines grow;
Where the swift brook runs and the big trout play—
O'er the hills and far away."

Since at this time so much is being said and done regarding the depletion and restocking of trout streams and public waters of the state, it occurs to me that a review of the causes largely responsible for present conditions will offer a moral and discourage their repetition so that future generations may enjoy the sport of fishing for trout, and may practice the "art of angling" in California.

It was long and faithfully believed by observing fishermen that all of the trout, colloquially called "mountain trout," "brook trout," "rainbow trout," "salmon trout" and "silversides," which inhabited the waters of the coastal streams of California, were steelhead trout. It is now known that steelhead belong to a particular group of fish anadromous in habits. Their connection with the sea is not an incident, but a potent element to the reproduction, growth and development of the species, and these facts are now well established by scientific investigation.

Many present-day anglers listen with deep interest and great wonder to the stories dad and "old timers" tell of the great catches they have made and of the big ones that didn't get away, during the good old days when the lakes, rivers and streams of California teemed with trout,

salmon and other game and food fish. Reflecting on present conditions, and with a deep sigh, they wish that they, too, could enjoy such sport with rod and line.

In 1867 I caught my first trout in Alameda Creek, near Sunol, Alameda County. My first real catch of trout was taken from San Gregorio Creek, San Mateo County, in 1869, and for thirty-five years thereafter I annually fished the streams of this and Santa Cruz County, as well as many other streams within the state.

During all of these years the catching of steelhead trout was not confined to hook and line. Night fishing and the sale of trout was not prohibited. The season opened above tidewater on April 1, but one



FIG. 6. A catch of nineteen steelhead trout on the Rogue River, Oregon, in October, 1897. Catches similar to this were made in California prior to 1921, when a limit of five fish a day during the winter tidewater season was fixed by law. Photograph by W. W. Richards.

could legally catch trout in tidewater during the entire year. It was not until about 1905 that a creel limit was placed upon the daily catch of trout.

Prior to 1905 and the enactment of a law fixing the daily creel limit at 50 trout, a catch of from 100 to 300 trout taken from the coastal streams by one fisherman during the day was not unusual. A catch of a dozen adult steelhead trout, or from 20 to 30 so-called "grilse" (one- and two-pound steelhead trout) was not exceptional. I can personally vouch for, since I have seen catches of this kind made in the San Gregorio, Pescadero, Butano, Waddell, Scotts, San Lorenzo, Soquel and Aptos creeks in San Mateo and Santa Cruz counties, to say nothing of the catches of steelhead trout that were made in Paper Mill Creek.

the Russian, Gualala, Garcia, Eel, Klamath and other coast rivers and streams.

Between 1895 and 1905 fishermen who sold their fish frequently made catches of from 200 to 350 trout per day in the streams of Santa Cruz County. These fish were sold at Santa Cruz at an average price of about 1 cent apiece, the average price paid for adult steelhead trout being about ten cents per pound.

In April, 1900, I saw 600 (four to ten inches) steelhead trout that had been taken on hook and line from Soquel Creek in Santa Cruz County, by one fisherman during one day. I have seen as many as 27 adult steelhead trout speared by one fisherman in Butano Creek, near Pescadero, during one night. I recall a catch of 618 trout and 21 adult steelhead trout taken on hook and line by four fishermen during one day in the lagoon at the mouth of San Gregorio Creek, in April, 1887.

During the sixties, seventies and eighties, thousands of so-called "grilse" or "salmon trout" were caught by hook and line by fishermen fishing off "Meiggs Wharf," from the wharves all along the San Francisco waterfront and off the Oakland Mole. On any Sunday during the fall months of these years hundreds of fishermen could be seen all along the wharves of San Francisco Bay and the Oakland Mole fishing for steelhead trout. The rig used by these fishermen was similar to that used by smelt fishermen, being a bamboo cane pole, cork float, and hooks baited with mussel, pile or angle worms, and fresh shrimps.

During the seventies and eighties I was able to take many a creel of nice trout from San Mateo, San Francisquito, Adobe, Stevens, Los Gatos and other streams in the Santa Clara Valley. Among the fishermen who fished for steelhead trout in the streams of the Peninsula and along the coast within 100 miles of San Francisco from the sixties to the nineties were Alex and James Butchart, Al Weeks, Al Goldson, Harry and Ed Thompson, "Stor" Armas, Dave Mills, P. P. Chamberlin, Lon Cook, Charley Green, Tom McLachlan, John Benn, John Butler, Al Wilson, J. P. Babcock, M. L. Cross, Ed Jenney, Harry Green, Ted and Bert Blanchard, "Bootsie" Griffiths and many others.

While the majority of these fishermen found their sport in fishing for adult steelhead in the lagoons at the mouths of the streams, Ed Jenney, Harry Green, Ted and Bert Blanchard and "Bootsie" Griffiths fished the streams of Santa Cruz County. Their outfit consisted of a light cane pole, a spool of linen tread which they used as a line, and a few snell hooks, sizes 7 to 9. With a few BB shot to be used as sinkers, and using sand fleas and angle worms for bait, they were able to exceed the catches, in both large and small trout, made in the streams by other fishermen.

While I have not had as much experience in fishing for rainbow and other trout native to the lakes and streams of the Sierra as I have had in fishing for steelhead trout along the coast, I have witnessed the depletion of trout in those lakes and streams. For years I had heard that the fishing for rainbow trout to be had in the Truckee River was not to be equaled in any part of the world, and that Lake Tahoe, Donner, Webber and Independence lakes teemed with trout of great size, but it was not until about 1902 that I was able to wet a line in those waters. In May of that year I went to Independence Lake,

where I saw four fishermen take one hook and line, and in a lawful manner, an average of 50 pounds of trout each per day. For several years these four men had made it a practice to go to Independence Lake each year during the months of April, May and June. Their daily average catch was 50 pounds of trout each, the trout being shipped from Corey's Station to Truckee, where they were sold for $27\frac{1}{2}$ cents per pound.



FIG. 7. A limit of steelhead trout ranging from 5½ inches to 13½ inches, caught on November 8, 1907, in the San Lorenzo River, Santa Cruz County, California. The fisherman is 13 years of age. During 1907 and 1908 it was unlawful to catch trout under five inches in length and to use fish eggs for bait.

For several years prior to the passage of the law which limited the daily catch of trout to 50 trout not to exceed 25 pounds in weight, not pounds but tons of trout were taken from Independence Lake during the months of April, May and June of each year, and were shipped and sold on the open market.

The conditions relative to market fishing for trout that prevailed at Independence Lake during these years also prevailed at lakes Weber, Donner and Tahoe and all along the Truckee River. I recall having stood on the banks of Blackwood Creek about 11 o'clock a.m. on a day in June, 1904, and in twenty minutes having counted no less than thirty adult trout pass a given point in that stream on their way upstream to their spawning beds. On the same day there were about twenty market fishermen in boats fishing for trout in Lake Tahoe off the mouths of Blackwood, Ward, McKinney and other streams that flow into the lakes. It is safe to say that during a number of years

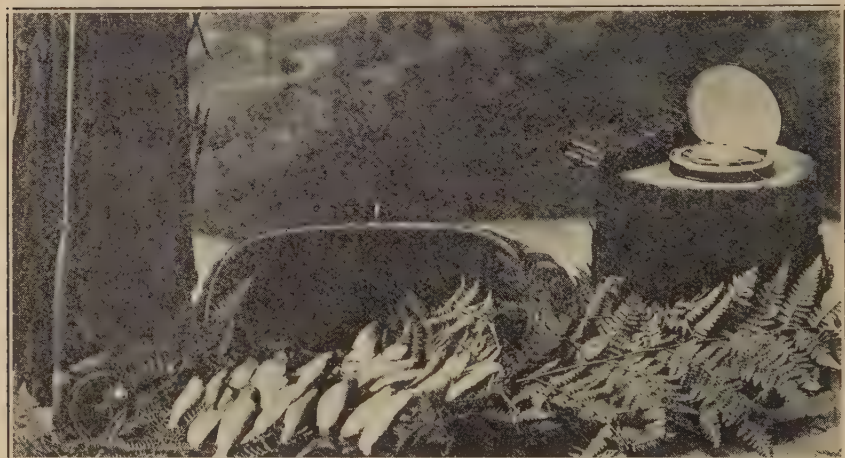


FIG. 8. Results of one hour with a fly on Soquel Creek, Santa Cruz County, California, in November, 1908. Photograph by Walter R. Welch.

before the law prohibiting the sale of trout in this state was passed, from one to two thousand pounds of trout taken from these lakes and the Truckee River were shipped daily and sold in the markets of San Francisco and other cities. The result was that the accessible lakes and streams of the Sierra, as well as those along the coast, were overfished and depleted of their once bountiful supply of native trout.

During the years mentioned anglers were known as "fishermen" and their rod and fishing outfit was referred to as "pole and rig." The reputation of being a fisherman was based on the number of fish one was able to catch, irrespective of size, how, when or where the fish were caught. The great majority, if not all, of the native trout caught during the months of April, May and June, and speared during the winter months, were either in a spawn-bearing, breeding or spent condition. What spring shooting did to our ducks and geese, this spring fishing did to our trout.

During the years of wholesale and oftentimes wanton fishing, those who angled with split bamboo rods, light tackle and flyhooks were

stigmatized as "sports." They were seldom to be seen on the streams in the spring months, and when they did put in an appearance were more or less sneered at.

It is needless to say that had there been more "anglers" or so-called "sports" and less "fishermen" during the early days, there would be more trout in the lakes and streams of the state today. The great majority of the old-time "fishermen" with pole, rig and spear have passed on and crossed the Great Divide. The "angler" with split bamboo rod, light tackle and flyhooks has now taken his place along the lakes and streams.

I am wondering if the anglers of today will be more considerate than the fishermen of yesteryear? I am wondering if the anglers of today will practice their art as a "source of recreation and refining pleasure," or will they be "fishermen" and continue the slaughter of spawn-bearing, breeding and spent trout during the spring months? I am wondering if the anglers of today

"With rod and creel will wander away
And cast a fly where the rainbows stay;
To feel the thrill when the game fish rise
And strike at the coachman flies."

or be "fishermen," and, using salmon eggs for bait, continue to creel fingerling trout irrespective of size.

Regardless of what the Division of Fish and Game may do towards restocking the streams and depleted waters, upon the answer to the above question rests the future supply of trout and the angler's opportunity to practice the art of angling in California.

GOLDEN TROUT PLANTING DURING 1928

By O. P. BROWNLOW

(With six photographs by F. A. Bullard)

There are more lakes and streams in the High Sierra of eastern Fresno County than in any other area of the same size in the State of California. The fact that most of these waters have continued barren of fish life has caused comment by the many tourists and campers who annually visit this wonderland, and has brought criticism of the Fish and Game Commission for its neglect to develop this important region.

With the idea in mind that some day this country would be the playground of thousands, A. D. Ferguson, who was in charge of the Fresno division in 1914, planned and directed the first pack train that transported golden trout from their native home in Tulare County to these barren waters. As time and money and the long distance these fish had to be transported on mules would not permit of an intensive plant, the fish were placed at strategic points. It was hoped that later, if the trout thrived, they could be distributed throughout the surrounding country and ultimately all this vast area would become a fisherman's paradise.

The writer was with the party that carried and planted the first golden trout in barren waters of the San Joaquin watershed. On August 24, 1914, our pack train of twenty-six animals crossed Piute Pass with trout taken from Golden Trout Creek in Tulare County. Having planted most of our load on the east side of the Sierra in Inyo County, we could only make a few small plants in Fresno County. On

this trip a small lake near Desolation Lake and French Canyon were planted. On August 25, 1914, Deputy F. A. Bullard and myself planted Marie Lake and the headwaters of Bear Creek. Less than 200 trout were available to make the plant.



FIG. 9. Pack train laden with golden trout at Muir Pass, Fresno County, California, August, 1928. Photograph by F. A. Bullard.



FIG. 10. Extending the range of golden trout. Seldon Pass, Fresno County, California, August, 1928. Photograph by F. A. Bullard.

From 1914 until 1928, there was no intensive planting of golden trout in this area. In 1928, Executive Officer Eugene D. Bennett, after a survey of conditions, approved the request that another pack train be placed in the field to further distribute these fish.

On July 1, 1928, Deputy F. A. Bullard, in charge of a crew of three assistants and eleven head of animals left General Grant National Park for Kennedy Canyon, where the first camp was made. From this camp 17 plants, totaling 1308 trout, were made in barren creeks and lakes. (See Map No. 1.)

On July 15 camp was moved to the head of Bear Creek. From the camps on Bear Creek and French Canyon, 89 plants were made in barren streams and lakes from Minnow Creek on the north, a tributary of Fish Creek, which empties into the middle fork of the San Joaquin, to Kennedy Canyon on the south, a tributary of the middle fork of the Kings River, a distance of approximately forty miles. The smallest plant was 20 fish and the largest 250. The total number of fish planted in this area was 6967. (See Map No. 2.) It should be borne in mind that all these fish were taken from waters planted to golden trout in August, 1914.



FIG. 11. Stocking a barren lake with golden trout. Evolution Lake, Fresno County, California, August, 1928. Photograph by F. A. Bullard.

Some of the lakes planted may not contain enough food for trout or may be lacking in other biological factors, but the fish will drift downstream to more suitable water. Thus, it is expected, there will be but slight loss.

All these plants were made according to spawning ground conditions. For instance, Hilgard Creek, a beautiful barren stream of water, having abundant spawning beds, received, in six plants, 369 fish so that it would be built up quickly.

Evolution Creek and the lakes of its headwaters were planted the heaviest, eight plants being made with a total of 1052 fish. This is one of the finest streams in the Sierra and has very few, if any, fish in it above the falls. Other smaller streams and isolated lakes received only from 20 to 50 fish.

Many wonderful lakes, such as Italy, Rose, Desolation, Murial, Evolution, Wanda, Martha, State, Horseshoe and Volcano, as well as many

unnamed lakes, were included in this year's plant. Lake Helen near Muir Pass, 11,612 feet, was one of the highest lakes planted, though many were over 11,000 feet in altitude.

All the fish planted this year were taken by hook and line, using barbless hooks or hooks with the barb filed off. This is the first time barbless hooks have been used by our fish planting crew and the results are so satisfactory that their use is recommended in future work.

The fish taken this year averaged from five to eight inches in length. Four of the pack animals were equipped with specially constructed pack cans known as the "Ferguson can." This can is so constructed that it fits on the side of the mule. It holds about six to eight gallons of water and will carry from 30 to 200 fish, depending on the distance and size of fish to be moved. These cans are covered with four thicknesses of burlap which, when wet, keeps the water in the cans at an even low temperature. The fifth set of cans was of lighter construction, built with knapsack straps and used to carry fish to points that could not be reached with pack animals.



Fig. 12. Trout-planting crew fishing for golden trout in Bear Creek planted in 1914. Bear Creek, Fresno County, California, August, 1928. Photograph by E. A. Bullard.

Considering results obtained and the benefits that may flow from these plants in the future, the cost of the whole summer's work was very small. They are as follows:

1 deputy, 2 months at \$160.....	\$320 00
3 assistants at \$85, 2 months 9 days.....	580 75
11 head of stock at \$1 per day, 71 days.....	781 00
Food, horse feed, etc., approximately.....	300 00
Total.....	\$1,981 75

If we may use the results obtained from plants made in 1900, 1910, 1913 and 1914, we are safe in saying that the greater majority of these fish will live and, as they were all adult trout, will spawn next season, which means that at least 3000 fish will deposit an average of 200 eggs

next season, or approximately 600,000 eggs. If only 10 per cent of these eggs hatch and reach maturity, we can say that the area planted is well stocked.

Deputy Bullard and his assistants have set a record in catching and transporting golden trout. In the seventy-one days from the time of leaving to the date of return they caught and planted in 106 different places a total of 8350 golden trout. They are entitled to a great deal of credit for such efficient work.



FIG. 13. Stocking Slide Canyon Lake, a barren lake, with golden trout. Slide Canyon, Fresno County, California. Photograph by F. A. Bullard.



FIG. 14. Four hundred golden trout were placed in this lake in 1928. Salt Lake, Fresno County, California, July, 1928. Photograph by F. A. Bullard.

The opening up of our mountains by means of state and federal roads, the building of roads by lumber and power companies, are causes that have contributed to the decrease of fish in streams and lakes that in 1914 were considered isolated. The trail from Blaney Meadow to the head of Bear Creek in 1914 was a dim path used only by cattlemen and an occasional camper, but when Deputy Bullard returned in 1928 he found this dim trail gone and in its place the John Muir Trail, the boulevard of the High Sierra. This trail passes through Seldon Pass and down Bear Creek. What will the next fourteen years bring? Certain there will be increased numbers of fishermen each year.

To meet the demands for fishing that we may reasonably expect in the future, this work with pack trains in the High Sierra should be continued. It will take at least another year to assure good stocking of the area covered by this report, and there will still remain much more work to be done. From Yosemite, on the north, to Sequoia National Park, on the south, a distance of 150 miles, there stretches a great wilderness where virgin nature reigns supreme. As wilderness areas become steadily scarcer and more prized for their recreational values, this area is destined to become a great American playground. Delay in stocking it now will only increase the difficulties and expense of introducing suitable fish in the future. Further, experience in transplanting golden trout has shown that the range of this fish can not be extended if the supply is taken from water heavily fished.

THE CRAB FISHERY OF MONTEREY BAY, CALIFORNIA

Catching the *Cancer magister* with Nets

By GEO. ROGER CHUTE

During the ten-year period between 1917 and 1928 the Monterey Bay crab fishery experienced two great fluctuations—the first a swift five-year decline, the second an even more rapid five-year rise. These trends, say the fishermen, tell the story of the failure and disappearance of one type of crab tackle and the later adoption of an entirely different mode of fishing which threw open to the crabmen areas of rich and virgin grounds where they had never been able to work before. But to an understanding of what took place there some knowledge of the local geography is necessary:

Monterey Bay is a mud-bottomed bight, indented, like a great horse-shoe, in a coast of rocks and cliffs. Just within the bay's north cape lies the little cove of Santa Cruz, and directly opposite, inside the south cape, in a corresponding position, is Monterey. Seaward from both towns the shore is rocky and the land high, but in the opposite direction, inward toward the bay, the bottom is smooth mud, the shore is sandy beach and the land makes off at low levels.

The fishermen of the bay, therefore, have at hand two entirely dissimilar water areas in which to operate, and it would be surprising indeed had the unlike nature of the bay and the Pacific Ocean not produced special adaptations of gear and tackle to meet the variances in working conditions which the two present. The modification of apparatus to meet diverse situations, and to overcome complex combinations of natural obstacles, has as one of its most conspicuous examples the gear used in the crab fishery.

The ports of Santa Cruz and Monterey, on Monterey Bay, are the most southerly contributors to the commercial catch of the king crab or *Cancer magister*. Although in distribution this crustacean is known to extend from Alaskan latitudes to Point Conception, it is not taken for market purposes south of the range of the Monterey boats. Both Santa Cruz and Monterey always have caught small but regular quantities of crabs, but never, until recent months, such tonnages as to affect, in a large way, the total for the state.

Crab-catching by the fishermen of both Santa Cruz and Monterey seems to have been practiced from early times. The gear originally utilized was the same as that used generally throughout the state, and was of the sort that is employed at the present time by the fishermen of San Francisco and more northerly ports. This tackle is called a "hoop-net" or "hoop," and is a baited apparatus consisting of a single metal ring of several feet diameter, with cotton webbing hung to fill its interior area, and lowered by a buoyed line to rest in a horizontal position on the ocean floor. The bait is secured in the center of the gear, and usually consists of fish or fish heads. When hauled, the webbing bags downward, forming a depression or pocket which experience has shown to be suitably effective in preventing the escape of the crabs that have been induced to approach the "hoop," and venture upon it, by the water-borne scent of the lure.

The "hoops" of the pioneer crabmen were set among the kelp and rocks, close to shore, outside the heads of the bay, in the Pacific proper. Crabs were known to abound inside Monterey Bay also, because the early trawlers that swept the bottom there with paranzella nets often took considerable quantities of them in that fishing, but repeated experiments proved to the crabmen that the "hoop" apparatus was useless as a means of capture within the waters of the bay itself.

Continued fishing depleted the "outside" Pacific ledges until only one or two boats remained at the "hoop" work, say the older men. This practical cessation of activity took place, however, during the period of depression following the World War, at a time when industries of many kinds, and fisheries in particular, reflected the unhealthy state of the country by curtailed production. Whatever may have been the cause of the decline, the statistics of the fishery show that from a combined total of 30,000 pounds of crabs caught by Santa Cruz and Monterey in 1918 the catch dropped to 2000 pounds in 1921.

Repeated attempts were made by "hoop" fishermen to operate with their gear within the bay. But two circumstances combined to defeat their efforts. One of these is that such depths of spongy ooze lie upon the floor of the bay that the "hoop" sinks from sight and is entirely buried in it. It is the popular belief that this concealment is so complete that the traveling crabs are not able to locate the bait, and never enter upon the trap. The second difficulty arises from the bay's being infested with a species called "hag-fish," known to the fishermen as "eels." The crabmen describe the hag-fish as an exceedingly rapacious animal, which will eat its way into a fish caught upon a long line, or even imprisoned in the cod-end of a trawl, and consume it entirely from within. This inedible pest is so numerous that within a few minutes after setting a crab "hoop" it will have eaten the last particle of the bait, say the fishermen.

Men of northern experience, skilled in the use of the "hoop" apparatus, still occasionally come to Monterey to try their tackle there. One of the most recent of these was a Russian who came in 1927 from Eureka and San Francisco with a complete outfit of northern crab gear. His trial sets were made with eight "hoops," and resulted in the capture of not one legal-sized crab. Two of the sets yielded a few imma-

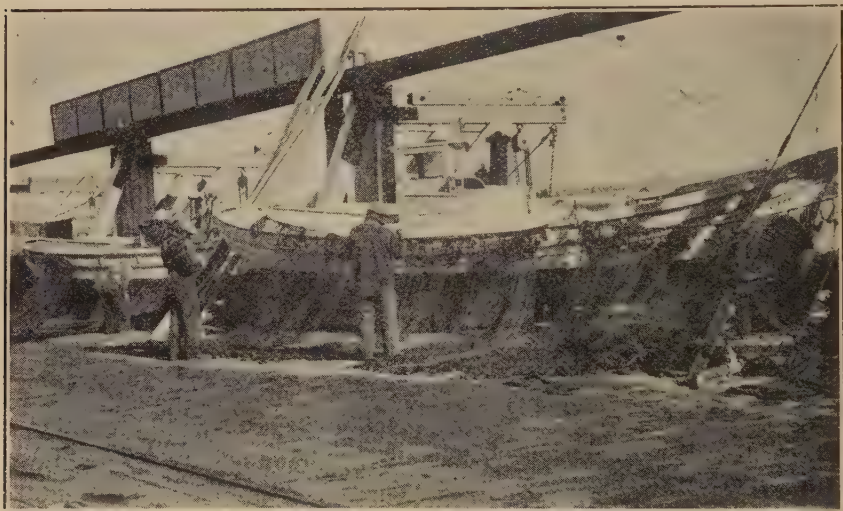


Fig. 15. Mid-day scene on the Municipal Fishermen's Wharf at Santa Cruz, California. Crab fishermen busy repairing the large-meshed gill nets. Photograph by George Roger Chute.

ture specimens; the others were entirely barren. The failure of the fishing was attributed entirely to the depredations of hag-fish. Notwithstanding that the baits had been covered carefully with two thicknesses of heavy burlap and then each enclosed in the customary basket of woven brass wire, the toothed "hags" had succeeded in gnawing an entrance, for the bait was entirely gone from six of the "hoops" and only a part remained in the other two. The Russian said that this attempt was made in twenty-one fathoms, in the same general locality where he now operates successfully with a different sort of gear. Since in the north his crab work had been done in six to sixteen fathoms, he decided to test shallower water, and did so. In six to eight fathoms he found that hag-fish did not interfere with operations, but that there were no crabs there, either.

The inability of the hoop-net fishermen to operate within the bay and the decline in productiveness of the rocky ledges of adjacent Pacific shore are cited as the reasons for the practical disappearance of crab fishing at the two Monterey Bay ports in 1921. Indeed, the year's catch at Monterey was exactly two dozen crabs! Santa Cruz landed only about 2000 pounds. But from that date until the present a swift change has taken place, the crab catch has greatly exceeded any in the past, and the Monterey Bay region has come to be a principal contributor to the total for the state. This happening is attributable to the employment of a new net apparatus, which has relieved the fishery from depending upon the "depleted" Pacific rocks by throwing open to exploitation the untouched areas of crab grounds inside the bay itself.

The crab net gear is of conventional gill net pattern, practically identical to and certainly the direct offshoot from the sea bass gilling nets still in common use in the kelp beds along the coast. Indeed, the modification of the sea bass apparatus for application to crab catching has been surprisingly slight. This will seem the less remarkable, perhaps, when it is remembered that various sorts of gilling gear set close inshore in Alaska often take quantities of *Cancer magister* or king crabs, and that south of Point Conception, in California, many spiny lobsters of all sizes are caught in the gill nets which fishermen place among the kelp and over the tidal rock ledges, ostensibly for the purpose of catching fish. It is hardly less than probable that the chance capture of large lots of crabs in sea bass gear was originally responsible for the first intentional use of the gill net as a crab-taking apparatus.

The Monterey Bay crab net is of 9-, 9½- or 10-inch mesh, light linen gilling twine. It is 40 meshes long by 18 deep, and measures approximately 30 by 13 feet. The foot-rope carries a disproportionately heavy load of oval leads threaded like beads upon it, so that the gear sounds quickly, the cork floats serving only to support the webbing in upright position on the bottom. Each net is provided with pennants or points for attaching to other segments or "pieces." It is the practice to tie together several nets in a "string" which is set on the bay's bottom like a strip of straight fence, the "string" being moored at each end with a dory anchor connected by a line to a floating buoy keg and a "marker" consisting of a flag-bearing bamboo staff about ten feet long. These buoys and markers are the only evidences visible on the surface

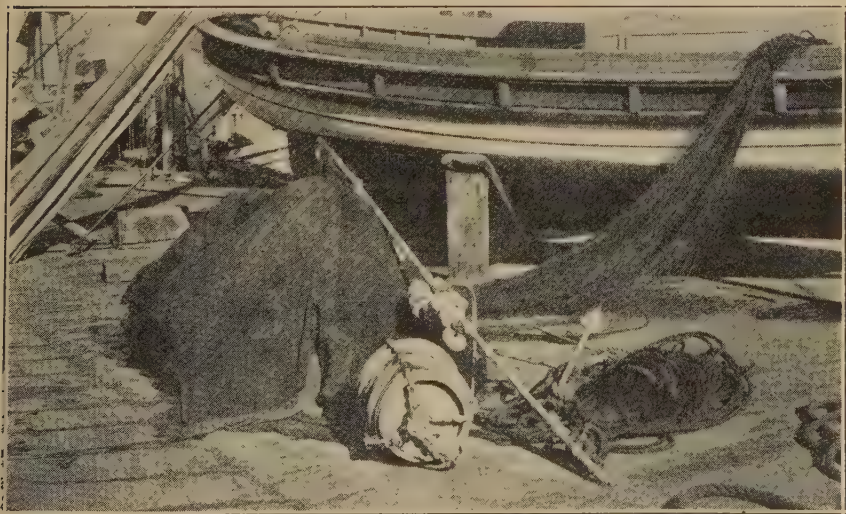


FIG. 16. Complete outfit of a Santa Cruz gill net fisherman. Photograph by Geo. Roger Chute.

to indicate the presence of the crab nets on the banks. It is the universal practice to paint this floating equipment in bright colors; this as an assistance to the boatmen themselves in locating their sets from a distance, and also for the sake of protective conspicuity, that the paranzella trawlers, who drag across these flats, may have warning to keep off the nest of anchors on the bottom.

The sets are made on the 20-fathom and 21-fathom shoals. Usually the fishermen will set a series of parallel "strings"—perhaps three, of three "pieces" each. The individual "strings" are run east and west, to the westward of Elkhorn Slough and the mouth of the Pajaro River. This is on a southeast bearing from the Santa Cruz municipal Fishermen's Wharf, or from Sequel Point.

In early 1928 there were 57 fishing boats registered at Santa Cruz, and an additional three at the neighboring anchorage of Capitola. A large proportion of this total of 60 boats, together with several additional operators from Monterey, fish crabs during at least a part of the season. The desultory operators sometimes work as few as two or three pieces of gear, but it is the testimony of the fishermen themselves that all crab boats making a serious business of the fishery carry an equipment of from 10 to 30 nets each. Only one-half of the gear is in the water at a time, the other half being ashore for purposes of overhauling and repair. From one to three men constitute a boat crew.

The boats leave Santa Cruz in the early morning, run to the grounds, pull their nets, set the repaired gear that they have brought from shore, and run back to port while disentangling the catch from the wet nets. Ordinarily the boats commence arriving at the wharf about nine in the morning, and by two in the afternoon the last of the fleet will be in.

The business of extracting a live and struggling crab from a fine linen net is an undertaking hardly to be appreciated by one not having tried it or at least witnessed it done. It would be hard to imagine an animal more completely wound up and ensnarled than the crabs which the fisherman finds "gilled" in his nets. All of the spiny corners and projections of their shell catch up the twine, and the leg joints especially become entangled until to extract the fighting prisoner seems a hopeless undertaking. But to meet this situation the fisherman has invented tools to assist him—implements looking very like the old-time, long-handled buttonhooks that our mothers used to have. With these hooks the crabmen can operate at a conservative range from the menace of gaping claws and continue with the patience-trying labor until he has the crustacean free. When the catch is heavy this is a long task, and one which is often finished on the wharf—sometimes with the assistance of the boatman's entire family.

The netters insist that their mode of fishing is not destructive of immature crabs, and that the undersized specimens which are returned to the sea are not so liberated in an injured condition or maimed to the extent of lacking one or more legs. The crabs do not hurt themselves while in the net, they say, and are usually entirely whole when removed. The leglessness so noticeable in the Santa Cruz catch results, they say, when the animals are released together in the bottom of the boat. Having been bound for hours in utter motionlessness, all of their energies have been preserved, and when, having been enraged by the untangling process, they are turned loose together, a free-for-all fight ensues that is a spectacle to behold. The crabs fly furiously at each other, like an arena full of raging gladiators. In the battle there are casualties to the extent of lost legs, but since the condition is one for which the fishermen have been unable to find remedy, the markets do not discriminate against crabs having missing members—in which regard the Santa Cruz dealers are more lenient than those of San Francisco, say the netmen.

Since the crab banks, where the nets are set, are in a remote and disused portion of the bay, the fishermen are spared that hazard to their gear which is always present when fishing is done directly in the path of marine traffic following the steamship lanes. No vessels have ever run amuck of the crabmen's set nets excepting on one or two occasions when San Francisco paranzella outfits failed to see the buoy kegs and the flags on the tips of the markers. In these instances the damage to the trawls by the nests of dory anchors was so severe that since that time the trawlers have stayed strictly away from the shoals where the crabmen are known to fish. However, a real hindrance to the business does exist, that being the daily damage done to the light weight twine by the sharks that blunder into it. Practically all of the repairs are made necessary by this cause.

The Monterey Bay crab catch has increased phenomenally, particularly of late. From the 2000-pound total for 1921 it rose to 50,000 in 1924 and then to 259,000 in 1927. During the first 90 days of 1928 the catch was 384,000 pounds, or 50 per cent greater than that for the whole year previous. Combining the last six months of 1927 with the first three months of 1928, the nine months' total is seen to attain the unprecedented sum of 511,000 pounds. How long the limited area of Monterey Bay can endure a drain of more than a half-million pounds of crabs a year is a question that can not fail to interest conservationists.

The Crab Catch of Monterey Bay

	<i>Santa Cruz</i>	<i>Monterey</i>	<i>Monterey Bay total</i>	<i>State total</i>
1918 -----	16,968	12,744	29,712	1,618,992
1919 -----	10,272	3,072	13,344	1,305,024
1920 -----	11,280	432	11,712	1,220,568
1921 -----	3,288	144	3,432	800,952
1922 -----	2,424	48	2,472	860,328
1923 -----	4,848	2,568	7,416	1,075,800
1924 -----	29,208	21,096	50,304	1,506,816
1925 -----	63,456	11,112	74,568	3,234,312
1926 -----	47,832	3,672	51,504	3,296,280
1927 (first 3 quarters) -----	130,224	1,248	131,472	2,251,360
1927 (last quarter) -----	127,512	336	127,848	773,952
1927 -----	257,736	1,584	259,320	2,960,352
1928 (first quarter) -----	372,768	10,944	383,712	1,367,184
1927 (last quarter) and 1928 (first quarter) -----	500,280	11,280	511,560	2,141,136

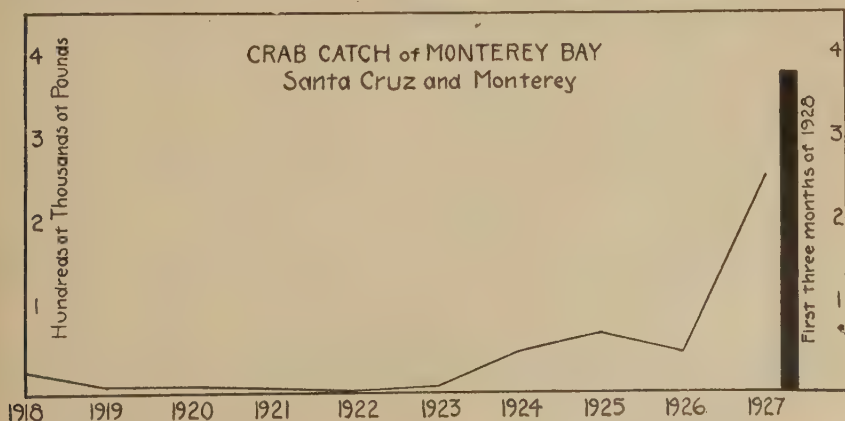


FIG. 17. The crab catch of Monterey Bay for the years 1918 to 1927.

SAN DIEGO TUNA INDUSTRY

By COBURN F. MADDOX

The fact that San Diego is fast becoming the tuna capital of the Pacific coast is evidenced by the marked increase of boats and catches in the last fiscal year, there having been considerably more than a two-fold increase in the amount of tuna fish delivered in that time. This marked increase in the so-called "high seas" boats and catches has been brought about largely by a desire on the part of the fishermen to eliminate from their operating expenses the excessive Mexican duties. These were, during the summer of 1928, \$35.31 U. S. gold per ton on all scale fish, being assessed as follows:

Exploitation Duty

4¢ Mex. per kilo (2.2 lbs. U. S.), 1000 kilo (1 Mex. ton) -----	\$40 00 Mex.
10% federal tax -----	4 00 Mex.
½% sales tax -----	20 Mex.

1000 kilo ton -----	\$44 20 Mex.
	22 10 U. S.

Exportation Duty

3¢ Mex. per kilo -----	\$30 00 Mex.
10% federal tax -----	3 00 Mex.
2% municipal tax -----	60 Mex.

	\$33 60 Mex.
	16 80 U. S.

Total duty -----	\$77 80 Mex.
	38 90 U. S.

One 2000-pound ton equals 907.6 kilos, which would figure out:

Exploit duty -----	\$20 06
Export duty -----	15 25

\$35 31 U. S. gold

This duty is too high and might be cut down if the assessments were made by the Department of Agriculture and Development (Secretaria de Agricultura y Fomento) only. It is claimed that, according to an act of the Mexican congress of January 7, 1925 (the law governing organization of members of the President's cabinet), the *only* department authorized to legislate and assess duties and taxes relative to the commercial fishing industry is the Department of Agriculture and Development.*

The Treasury Department of Mexico, in alleged violation of this act of congress which gives all authority to the Department of Agriculture

* On December 21, 1928, an official decree signed by President Calles became effective changing the Mexican Fish Tariff Act on Exploitation Duty, paragraph 87, to read as follows:

Exploitation Duty

2½¢ Mex. per kilo (2.2 lbs. U. S.) 1000 kilos (1 Mex. ton) -----	\$22 50 Mex.
10% federal tax -----	2 25 Mex.
½% sales tax -----	11 Mex.

1000 kilo ton -----	\$24 86 Mex.
	12 43 U. S.

Exportation Duty

3¢ Mex. per kilo -----	\$30 00 Mex.
10% federal tax -----	3 00 Mex.
2% municipal tax -----	60 Mex.

\$33 60 Mex.

and Development to assess and collect duties, has placed in its tariff an export duty on fish and fisheries products in addition to the duty or tax already fixed by the department authorized to fix said tax or duty.

The principal reason the duty or tax on fish and fisheries products is so excessive and prohibitive is that the Department of Agriculture and Development taxes fresh fish, say, 4 cents Mexican per kilo, and the Treasury Department taxes this same fish, say, 3 cents per kilo; in addition to that a 10 per cent federal tax is assessed by both departments; a 2 per cent municipal tax is assessed on the export duty and a $\frac{1}{2}$ per cent sales tax (renta interior) is assessed on the exploitation of Department of Agriculture and Development tax. Were these facts brought to the proper authorities through the right channels, calling attention to the fact that the Treasury Department tax is technically a violation of their own laws in taxing a commodity already taxed by the proper authorities, the present exploitation tax of \$16.80 per ton might be eliminated, leaving only the Department of Agriculture and Development taxes of \$22.10 per kilo, or \$20.06 per 2000-pound ton.

Another method suggested of reducing the present high duty is that of a sliding scale of duties which might be agreed upon. Low priced fish, such as skipjack, should not have the same duty as higher priced fish, such as yellowfin or bluefin tuna. The duty might be governed by the price of the fish when sold; if halibut sells for 8 cents per pound, have the tax a certain relative amount, and if it is 12 cents, add so much more. In other words, make the duty on an ad valorem basis.

In all fairness to the Mexican government, it should be said at this time that the main reason these duties have been raised is that Mexico City was not receiving the revenue that should have been derived from this source. This is due to two facts. First, in many cases the Mexican inspectors were tricked out of the duty on many tons of cannery fish by American fishermen by various methods, which decreased the income of the Mexican fisheries offices located in San Diego and San Pedro. Second, it is claimed by the Mexican government, and in some cases proved, that not all of the amount of the duties paid into those offices by American fishermen and packers reached Mexico City. Therefore, to secure a sum adequate to operate this branch of her government, the Mexican officials increased duties, in the hope of obtaining a greater per cent of income.

A sincere effort was made by Colonel Jose M. Tapia, while in charge of the San Diego office of the Mexican Fisheries Service, to get the Mexican export duty reduced to an amount that, when paid, would leave a reasonable profit for the fishermen. Colonel Tapia was more than fair in his dealings with the American fishermen, but in his

	16 80 U. S.
Total duty -----	\$58 46 Mex.
	29 23 U. S.

One 2000-pound ton equals 908 kilos which would figure out:

Exploit duty -----	\$11 29
Export duty -----	15 25
	\$26 54 U. S. gold

As is shown by the above table this reduction lowers the total duty from \$35.32 to \$26.54, making a saving to fishermen of \$8.78 U. S. currency on one two-thousand-pound (2000 lb.) ton, and though this present duty is considered by the industry as fair enough for fresh market fish it is still considered too high on cannery fish.

apparently sincere efforts to put an end to the duty dissension by a reduction of the tariff, he was not successful, having met with opposition in Mexico City.

The full importance of this phase of the industry may be seen in the following statistics on tuna for the fiscal years 1926-27 and 1927-28,

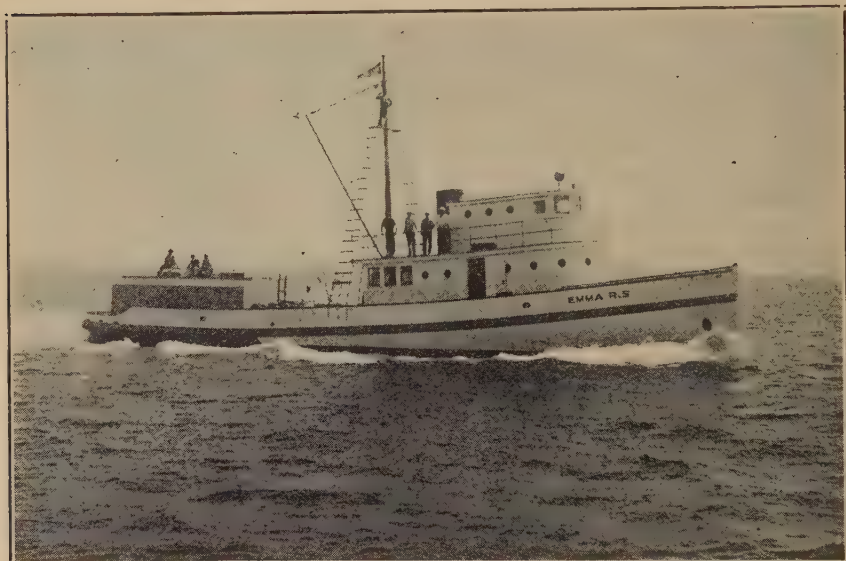


FIG. 18. The *Emma R. S.*, operating out of San Diego, California. A new high seas fishing boat having a cruising radius of 3000 miles.

there having been delivered at San Diego alone, mostly from south of the international boundary, 46,929,672 pounds of this fish as follows:

Fiscal year 1927-28.....	29,483,367 pounds
Fiscal year 1926-27.....	17,446,305 pounds
Increase.....	12,037,062 pounds

This increase of 6019 tons of cannery fish in the last fiscal year was brought about by the necessary addition to the San Diego fishing fleet of nineteen new boats (see appended list) at an expense of approximately \$958,000. These are all high seas, Diesel-type boats and are able to cruise to remote banks, as they have an average speed of $10\frac{1}{2}$ knots per hour and a cruising radius of from 2500 to 6000 miles. All are insulated with cork, being in effect huge refrigerators, and have bait tanks which will hold from four to six tons of live sardines and keep them alive for three weeks. In the case of the *Emma R. S.*, the bait tanks are also cork-insulated and may be used for storage of the catch in emergencies. These boats are equipped with either gasoline, crude oil or electrically powered auxiliary engines which operate the bait-well pumps, winches, light plants and other gear. The galleys are on the main deck and are most compact and complete. All are equipped with electric refrigerators and up-to-date plumbing systems. The crew, from eight to twelve men, have palatial, light, airy quarters, the equal

of many passenger boat staterooms. For such fishermen, the days of sleeping in dark, ill-ventilated cubbyholes are past.

In a way, this change from the old-style, small bait boats to these large fishing vessels will revolutionize the fishing industry. It is no longer necessary for canners to hold barges at Turtle Bay, Todos Santos and other points in Mexican waters off the coast of Lower California, for receiving fish to be delivered to the canneries by tender. This was always an expensive operation, necessitating handling the tuna at least four times—first, on the boat making the catch; second, from the boat making the catch to the barge receiving same for the packer; third, from the barge to the tender; and, fourth, from the tender to the floor of the plant canning the fish. Every step in the old way of handling bruised the meat just a little bit more. By the elimination of two of the most injurious of these operations—the time on the barges and icing aboard the tenders—the value of the catch is greatly increased and a big improvement is effected over the old, and what will soon prove to be, antiquated methods.

The new boats may hold the fish thirty days if necessary, and then deliver it direct to its destination. Because the fish has not been handled so much or exposed to flies and heat, as it was when held on the barges, the canneries will thus receive it in better condition. The new method will result in benefit to all concerned, from the fishermen

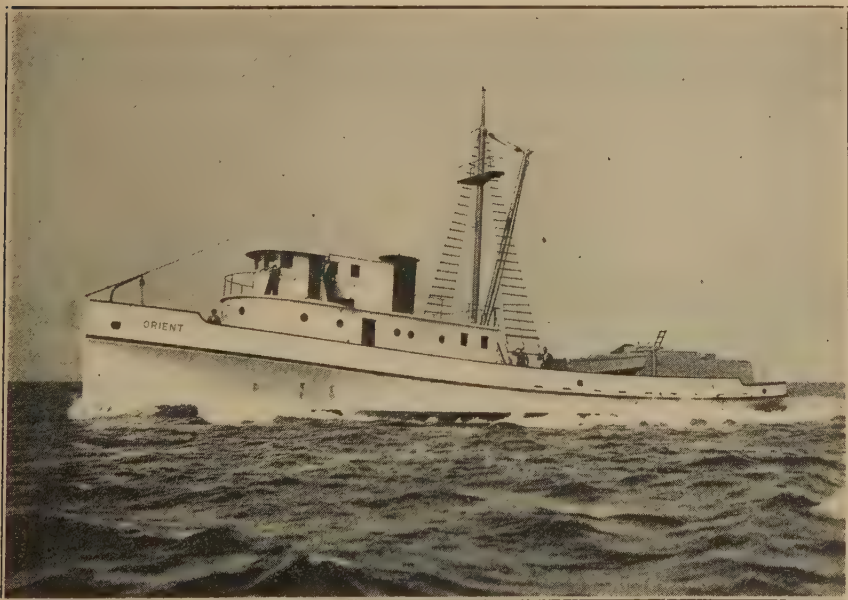


FIG. 19. A recent addition to the tuna industry of San Diego, California. The *Orient* has a cruising radius of 6000 miles.

who will profit because of elimination of duties and their ability to deliver a better product with no cut for spoiled fish, to the consumer who will receive a better pack from the canner at no increased expense. However, it will limit the operations of the small boat largely because of prohibitive duty and lack of fueling and icing capacity.

The two most outstanding boats of this new fleet are the *Emma R. S.* and the *Orient*. The former is electrically equipped throughout and has a short wave radio telephone and telegraph outfit. This will enable her to go places heretofore avoided by fishermen, due to danger in case of breakdown, since they were out of any steamer route and a chance of rescue was doubtful. The *Emma R. S.* may communicate with San Diego and other vessels at all times. Her forty meter signal outfit will keep her in touch with the time signals of the Arlington station, thereby assuring her captain, Guy Silva, the correctness of his navigation.

The *Orient* is the only all-metal fishing boat operating out of San Diego. It is captained by Joe Sousa, who may well be proud of his 113-foot steel fishing boat, which is decked over and whose gunwales are incased in wood to protect the fish from the heat of the metal in hot weather. Being built of steel, reduces her bulk and thickness of hull. It also permits thicker insulation and increased cubic space in cargo hold on the same wooden boat dimensions. She has the largest fuel capacity and bait-tank dimensions (50 tons water, and storage 150 tons of iced fish) of any of the boats her size. Further, being constructed of steel has reduced the fire hazard. She has a total of nine inches of insulation in her fish holds, seven inches of cork and two inches of wood, with only four inches inside the frame. This type of insulation on a wooden boat would take a total of sixteen and three-fourths inches, where the outside beam of both vessels is the same. This makes it unnecessary for the *Orient* to have as large an ice machine, thereby greatly reducing the amount of pipe necessary in its construction. This in turn reduces the weight of the ship, the amount of machinery and power necessary to run the ice and pumping machines, and lessens fuel consumption and cost of operation.

TABLE OF NEW BOATS FISHING FOR SAN DIEGO CANNERIES

Van Camp Sea Food Company

Name of boat	Captain	Built	Length, feet	Net ton	Engine	Cruising radius, miles
Emma R. S.-----	Guy Silva-----	San Diego----	95	75	400 FM*	3000
Grey Hound-----	Manuel M. Medina-----	Sausalito-----	115	110	450 WE	3000
Glory of the Seas-----	O. H. Dickason-----	San Diego-----	117	141	400 U	3500
Funchal-----	Obilio C. Pires-----	Sausalito-----	115	126	360 AI	3500
Mariner-----	Joe Monise-----	San Diego-----	115	95	350 U	4500
Adventurer †-----	A. Felando-----	San Pedro-----	115	95	300 U	3000
Patriotic †-----	Y. Ryono-----	San Pedro-----	81	50	210 FM	3000
Sacramento †-----	Santo & Souza-----	San Pedro-----	115	95	400 FM	3500

Westgate Sea Products Company

Conte Verde-----	Laurie Massa-----	San Diego----	80	52	180 WE	3000
Flying Cloud-----	T. Yamaguchi-----	Long Beach----	103	129	360 FM	8000

California Packing Corporation

California-----	Manuel Silveria-----	San Diego----	114	94	300 U	5500
Taiyo-----	N. Seki-----	San Pedro-----	114	112	375 WE	5500
Del Monte-----	Manuel Freitas-----	San Diego-----	90	53	225 U	3000
St. Veronica-----	John Cardosa-----	San Diego-----	114	94	300 U	5500

* Abbreviations of kinds of engines as follows:

FM—Fairbanks-Morse (3).

WE—Western Enterprise (4).

U—Union (7).

AI—Atlas Imperial (4).

† These boats are to deliver their fish to Van Camp's San Diego plant, according to Van Camp's San Diego manager, A. K. Johnson, who also gave me the net tonnage of the *Patriotic* and *Sacramento*; the net tonnage of the *Adventurer* being given me by the Campbell Machine Company, as the local custom nouse has no record of these three boats.

Cohn-Hopkins, Inc.

<i>Name of boat</i>	<i>Captain</i>	<i>Built</i>	<i>Length, feet</i>	<i>Net ton</i>	<i>Engine</i>	<i>Cruising radius, miles</i>
G. Marconi -----	M. Crivello -----	San Diego----	85	65	200 AI	2500
Stella Di Genoa----	Fred Canepa -----	San Diego----	109	97	300 U	2500
St. Therese -----	Frank Silva -----	San Diego----	110	99	375 WE	3000

K. Hovden Company

Point Loma -----	Manuel Perry -----	San Diego----	95	75	350 AI	4500
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San Diego Packing Company

Orient -----	Joe Sousa -----	San Pedro --	112	121	350 AI	6000
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Other new high seas fishing crafts operating out of San Diego are:

Abraham Lincoln	Milwaukee
Amour Da Patria	New Princess
Atlantic	Olympia
Betty B	San Antonio
Calpac	San Diego
Chesapeake	San Joaquin
Enterprise	Supreme
Lisboa	Uncle Sam
Lois S	Vasca Da Gama
Lusitania	

THE FOOD OF TROUT

By GEORGE A. COLEMAN

The more I study the data available from the dissection of the stomachs of trout caught in our lakes and streams, the more I am convinced that our trout in the wild state exercise great powers of selection of their food from the available natural supply, whether that be insect or crustacean.

Just what the factors are that govern this selection is a problem which has not yet even been worked upon.

The contents of the stomach of a trout caught in any lake or stream on any given day does not by any means determine the food of that trout through the year. It is simply an index of the available supply of food for that particular section of the lake or stream where the trout was caught and of what the trout in question selected during the day.

There is frequently a great variety in this daily menu. I am often very much surprised to find not a single specimen of the insect or crustacean which is in the greatest abundance and by all man-made rules should fill that trout's stomach to bursting. I have often watched young trout fry, only an inch or so long, jumping at gnats, or midges, on the surface of the water. I have observed them catch and swallow insects almost as large as their heads when they could, without any trouble, be quietly taking great quantities of minutes crustaceans available in the water. This must be explained as some biological urge of which we know nothing, otherwise we would put it down as just "pure cussedness."

In order to make sure that my eyes did not deceive me in this matter, I caught and examined the stomachs of some fry, but ten days old. The collection was made between 10 and 11 a.m. after a good morning's meal. One such lot gave the following results:

15 fry averaging 25 mm. in length—

Average number gnats (2 species) -----	20 each
Chironomous larvæ -----	1 each
Young water boatmen -----	1 each
Crustacea (very abundant) -----	2 each
Water fleas -----	2 each
Water fleas Daphnia -----	1 each

It would seem, in this case, that in spite of the prevalence in the water of thoroughly good natural food, the instinct to jump and catch food on the surface was stronger than the mere hunger urge—even at this early age.

On the other hand, when circumstances require it, young trout will go to any trouble and exercise great ingenuity in obtaining food. An instance illustrating this fact occurred during the course of an exploration on the headwaters of the Kern and the Kings rivers late in September of 1924. This was an exceptionally dry year. We found many instances of small tributary streams which were dried down to a series of mere pools only a few yards in extent. In many cases, these would be a mass of decaying vegetation and mire. In these, I often found hundreds of young trout, 2½ to 4 inches in length, their stomachs filled with the larvæ of *Chironomous* (a midge) and other insect larvæ which were available in the mud of these pools. This adaptation enables the young trout to survive until the middle of October, when the early snows would supply these streams with water, and these trout would again be able to assume a somewhat normal existence.

Thus, mother nature has provided the fish organization with wonderful powers of adapting itself to its environment. If this were not so, the fish culturist would never be able to take fish from their natural environment and place them in entirely artificial surroundings with artificial food, and still make good fish of them.

Age has a great influence upon the selection of the daily menu of trout. Apparently they become cannibalistic in their tendencies after they are a few months old and become more so as they reach adult size. It further seems that they find it easier to devour a few of their fellows, who have already fed on insects, than to hunt up their own insect or crustacean food. It, therefore, takes something unusual in appearance in the way of an insect or crustacean, alive or in artificial bait, to attract a big fish whose predaceous instincts are fully developed.

The question whether a given stream or lake is suitable for trout and, if so, how many it will support, is one which can not be determined definitely by a hasty survey of that lake or stream on any given date. The plant life plankton, insect and crustacean food must be studied at different seasons in order to obtain reliable data on the available supply throughout the year. Physical data, such as temperature, dissolved oxygen and carbon dioxide and chemical composition, must also be noted. Then, if there are trout living in the lake or stream, collections of these and examination of their stomach contents at different seasons will give further reliable data.

Another study, which should engage our attention before any extensive planting of our barren lakes at high altitudes with either plant or insect food is undertaken, is an intensive study of the life histories of a few of our more abundant aquatic insects which we know to be frequently taken by trout for food. This study should further embrace an investigation of a few of the most abundant crustaceans, their

requirements for food, temperatures for growth and other physical requisites.

As we compile more and more data on the food requirements of each species of trout, and gain more knowledge about the plant, insect and crustacean life of each lake and stream, we will arrive at a sounder and more scientific basis upon which to rely for the distribution of the trout from our hatcheries.

NEW ACCESSIONS AT LIBRARY OF CALIFORNIA STATE FISHERIES LABORATORY *

The library of the California State Fisheries Laboratory has been most fortunate recently in obtaining missing back numbers of serials. In a special library such as this, "finds" of this description are rare and are valued in proportion. We have been successful also in obtaining books, of which twelve of the most interesting are listed below:

1. Afalo, F. G. British salt water fishes. With a chapter on the artificial culture of sea fish, by R. B. Marston: Hutchinson, London, 1904.
A descriptive account of the most important groups of fishes of this region.
2. Alexander, W. B. Birds of the ocean. A handbook for voyagers. Containing descriptions of the sea birds of the world, with notes on their habits and guides to their identification. Putnam's, 1928.
3. Couch, Jonathan. A history of the fishes of the British Islands. Groombridge, London, 1867.

One of the classics on ichthyology. The four volumes are illustrated with 252 colored plates.

4. Daniel, R. J. Animal life in the sea. University Press, Liverpool, 1928.

This is a short popular account of the organisms, both plant and animal, living in the sea. The animal species considered are mainly the larger, more conspicuous forms.

5. Elton, Charles. Animal Ecology. Sidgewick & Jackson, London, 1928.

A work applicable to the problems encountered by those endeavoring to understand the changes taking place in fish populations.

6. Floud, Sir Francis. The ministry of agriculture and fisheries. Putnam's, 1927.

The author, who was the Permanent Secretary to the Ministry from 1920 to 1927, has written a very readable account of the work of the Ministry. The chapter on the Fisheries Department, by Henry G. Maurice, Fisheries Secretary to the Ministry, is regrettably brief.

7. Harvey, H. W. Biological chemistry and physics of sea water. Macmillan, 1928.

The author, who is hydrographer at the Laboratory of the Marine Biological Association, Plymouth, England, takes up the chemistry of sea water, water movements, the significance of temperature, and in the concluding chapter gives a very interesting account of the chemical and physical factors controlling the density of population.

8. Haskell, Allan C. How to make and use graphic charts. Codex, New York, 1920.

A highly technical work which contains much valuable material that can be directly applied to the making of charts and graphs used in fisheries publications.

9. Hulit, Leonard. The salt water angler. A compendium of information for the salt water fisherman. Appleton, 1924.

10. Jenkins, J. T. The fishes of the British Isles. A handy pocket guide, with descriptive text. Warne, London, 1925.

Contains 278 illustrations, 128 of which are colored.

11. McKerrow, Ronald B. An introduction to bibliography for literary students. Clarendon, Oxford, 1927.

A useful work giving the marks that may reveal the history of a book from its material form and makeup.

12. Wilcocks, J. C. The sea fisherman or fishing pilotage. Comprising the chief methods of hook and line fishing in the British and other seas, a glance at nets, and remarks on boats and boating. Barbet, Guernsey, 1865.

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* Contribution No. 75 from the California State Fisheries Laboratory, compiled by Genevieve Corwin, Librarian, October, 1928.

CALIFORNIA FISH AND GAME

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"... we have so increased the number of sportsmen fishing in our streams and lakes that the longer time between bites is becoming a political issue."—Herbert Hoover.

THE FUTURE

There is possibly no division of state government confronted with such difficult and uphill problems and yet more subject to critical scrutiny than the Division of Fish and Game.

The extensive growth in population and development of our state continues to circumscribe and draw upon the supply of fish and game in manifold ways. More than a half million license holders, whose numbers are rapidly mounting, finding less available and abundant the sources of their favorite sport and recreation, outspokenly demand more results from the fees they pay, many of these having divergent views of how such results are best obtained.

The division is now confronted with and probably always will face the impossible task of pleasing or satisfying all. Endeavor as we may, there will always be some to criticise and find fault. This should not, however, deter us from seeking and carrying out the course best calculated to bring the greatest good to the greatest number.

Conservation and restoration of wild life, to be effective, is dependent on certain fundamentals and is best accomplished by pursuing a definite program which should not be radically overturned or varied from except where new or changed situations arise, and then only after scientific experience and knowledge point the way.—EUGENE D. BENNETT, Thirtieth Biennial Report, Division of Fish and Game.

THE THIRTIETH BIENNIAL REPORT

The work of conserving and protecting the fish and game resources of California

is becoming with the years a more complex problem. It is true, the science of game management has discovered and developed certain fundamentals and that the correct practice of these so-called fundamental methods has in many cases brought about much of the desired protection and restoration. It is also true that the development of the state and the exploitation of its natural resources have made the difficulties of maintaining the state's wild life resources more acute and burdensome.

To make certain a better solution of these problems, the division has been faithful to a plan of centralized and uniform administration during the thirtieth biennium of the division. It has further followed a definite and consistent program. This program has for its object the maintenance of fish and game resources in existing remnants of natural areas, the adjustment to bring about suitable conditions for wild life survival in other areas where the natural environment has been changed or modified by a vigorous and thriving civilization, the replacement of native species with introduced species that will flourish in spite of cultivation, and, lastly, the artificial assistance of nature to increase her reproductive capacity, which, in the case of fish, makes possible the production of literally millions of fish.

The Thirtieth Biennial Report of the division epitomizes the accomplishments made during the past biennial period. The income for the fiscal year of 1928 was \$850,000. This is an actual increase of \$37,051.35 over the seventy-eighth fiscal year. This larger revenue, however, has permitted enlargement in scope of every major activity of the division, has made possible the extension of its endeavors to fields of action greatly needing attention and permitted many worthwhile opportunities to be grasped of great importance to the needs and pleasures of generations to come.

Increased revenue has made possible an enlarged patrol force. The division now has 120 law enforcement officers, making effective and efficient patrol now possible in every section of the state. Records show that deputies made 2317 arrests for violations of the hunting laws and 4390 arrests for violations of the fishing laws. Court fines increased from \$56,742.64 in 1926-27 to \$72,109.70 in 1927-28.

Increased revenue has enabled such hatcheries as were in bad need of repair and improvement to be placed in a more workable condition, thus permitting the bureau to increase its output of fish and offset the increased drain on streams. Thirteen new hatcheries have been con-

structed, nearly doubling the existing number. These are located at strategic places remote from existing hatcheries and should improve fishing in waters adjacent to them. The output for the biennium was 51,444,562 trout and 26,728,590 salmon. The greater majority of the trout were planted by experienced deputies, being scattered in the more favorable locations where big fish have difficulty in preying upon them. A new fish planting truck has made possible the movement of fry over long distances not reached by rail with practically negligible loss.

Increased revenue has allowed enlargement of the personnel of both the Bureau

disaster of 1906 has been established. Contributions have been made to the relationship of birds to agriculture through field investigations of life histories and habits of birds.

Exhaustive investigations have been conducted by the Bureau of Research in cooperation with the Hooper Foundation for Medical Research to ascertain "the cause and means of prevention" of the so-called duck disease. Studies have also been made of the life cycles of internal and external parasites of deer, quail, pheasants, ducks and geese and other species.

For the first time in the annals of the state an actual record of the number of



FIG. 20. Mud bottom rising out of water of Tule Lake, where duck sickness was prevalent. Tule Lake, Modoc County, California. October, 1928. Photograph by E. S. Cheney.

of Education and the Bureau of Research. The former was a one-man bureau and its functions were limited to the ingenuity and capacity of its director. Additional lecturers have materially expanded the scope of its educational activities and permitted personal contacts with schools and colleges, service clubs and lodges and conservation organizations in every section of the state. Two cameramen experienced in wild life photography have been employed and many reels of motion pictures have been produced, capable of winning a more sympathetic appreciation for the work of the division and its wards, the living things of the state. The first reference library since the San Francisco

deer killed and of the number of fur bearers taken by trappers has been obtained. The information that may be secured from such statistics is of great value in the formation of game administration programs. When records show that a species suffers progressive diminution from year to year, it is a sign that depletion has set in. Ability to detect when the breeding stock of a particular species is being impaired, resulting in diminishing returns in the annual birth rate, is fundamental in the successful practice of game management. The biennial report shows that a plan is now well under way to make an accurate analysis of game conditions and take a

state-wide census of California's game resources.

Increased revenue has permitted the employment of a game refuge survey crew which will survey and post the 2,372,355 acres now closed to hunting. Already many refuges have been surveyed and posted and the completion of this work will make possible better functioning of these important areas conserving a nucleus of mother stock.

The past two years have witnessed the completion and dedication of the state's game farm. Several minor, though not unimportant additions have been made at the Yountville Farm, probably the largest completely roofed-by-wire enclosure of its kind in America. Three thousand Chinese ring-necked pheasants were planted the first year and nearly eight thousand the second, so that now Chinese ring-necked pheasants are found in practically every part of the state where climate and topography permit their continuance.

Through the efforts of the Bureau of Hydraulics nearly eleven hundred important streams and ditches throughout the state have been screened to prevent fish from being diverted to irrigated lands or other places where they are lost to the angler.

Over four hundred fishways have been installed to permit the free migration of fish over dams and other obstructions. The pollution situation in the state, principally in bay and ocean waters, is reported to be in a far more satisfactory condition than ever before. Oil pollution has a decided detrimental effect on fish and even birds.

Control and regulation of the commercial fishery industry and fishery products of the state to safeguard the fishes of the sea and prevent overfishing has been not without its trials. In the sardine canning industry, the manufacture of by-products and the reduction of these food fish to fertilizer appears to be the most profitable part of the business. Litigation has been resorted to in order to successfully enforce the fish reduction and commercial fishery laws. The Commercial Fishery Bureau has assisted in efforts to prevent botulism in canned fishery products by contributing \$15,000 a year to the Hooper Foundation for Medical Research. The bureau has made beneficial strides in the eradication of carp from Clear Lake and conducted a valuable survey of the sea lions of the California coast. Through its laboratory located at Terminal Island, it has made many valuable studies and scientific investigations of marine fishes. A knowledge of the supply, breeding grounds,

habits and other characteristics of fishes of commercial importance is not only of practical aid to the commercial fishing and canning industry, but also provides a means of more accurately determining the proper rules, regulations and laws necessary to insure their conservation.

Two measures inaugurated during the thirtieth biennium have an important bearing on the future: The appointment of a committee provided by the legislature to investigate and to recommend game refuge sites and public shooting grounds, and the power granted to the Department of Natural Resources to close lakes and streams. These measures will play a considerable part in future accomplishments of the Division of Fish and Game.—RODNEY S. ELLSWORTH.

THE NATIONAL COMMITTEE ON WILD LIFE LEGISLATION

The president of the Fish and Game Commission, I. Zellerbach, has been honored with a place on the National Committee on Wild Life Legislation. He will represent the Western Association of Fish and Game Commissioners in the important and far-reaching work of the national committee.

The organization of the national committee has been heralded as the most advanced step ever taken in behalf of the wild life of America. The reason for such high praise is not solely due to the magnitude of the task which the committee will set before itself to accomplish, but it is also due to the fact that the recognized leaders in conservation affairs throughout all America are represented on the committee.

The best conservation thought of the entire nation will be brought to bear on the problems dealt with by the committee, which has announced, as its first order of business, the passage of the Norbeck Game Refuge Bill.

DEER KILL FOR 1928

According to the information compiled from the duplicate deer tags, hunters killed 21,515 deer during the 1928 season. This is 2008 more than were accounted for by the rifles of deer hunters during the year of 1927, when the first accurate count of the deer kill was possible.

Again, Siskiyou County leads with 1654 deer killed. Mendocino County is second, hunters operating in this section killing 1468 deer. Lake County is third with 1038.

San Francisco County, being entirely a metropolitan district, produced no deer. Los Angeles County, however, covers a huge area and furnished big

game devotees with 369 bucks. In Sacramento County but two deer were killed. In Sutter and Kings counties, three fell. Imperial furnished four, while San Diego, the adjoining county, contributed 232 of the deer killed.

REQUISITES FOR CALIFORNIA WATERFOWL

No species of wild life can be assured of perpetuity in the face of an aggressive and vigorous civilization without the requisites of adequate food, natural cover affording safe retreat from enemies, and uncontaminated breeding grounds. In this light, it should seem self-evident that restrictive hunting as a method of conserving species has its shortcomings.

A study of any good map issued before 1890 will show an almost unbroken marshland extending up and down the great interior valley of California. Had airplanes been invented previous to 1890, an air reconnaissance of the migratory bird areas of the state would have disclosed vast overflow areas and the expanses of Tulare and Buena Vista lakes. Below the observer, countless thousands of smaller patches threaded by sloughs would have given their shining signals.

Now, during the late summer and fall, probably as much as 80 per cent of these water areas, so eminently suited as loafing and feeding grounds for the myriads of waterfowl that formerly haunted them, have disappeared. Reclamation, drainage and evaporation are responsible for this great reduction. Reproduction of waterfowl in the state has decreased in proportion to the reduction of suitable nest sites, while the number of ducks and geese wintering in California have correspondingly decreased, for dry land never attracts waterfowl.

Duck hunters have viewed with alarm the rapidly thinning flight of migratory birds, but there will be no danger of their extermination. The constructive steps being taken by the members of the Governor's Advisory Committee on Game Refuges and Public Shooting Grounds will insure a future to this popular sport.

The survey now being conducted by the committee has primarily for its purpose the establishment of refuges that will hold and sustain waterfowl during the open season in sufficient numbers to maintain an adequate breeding stock, and, secondly, the creation, by purchase, lease or rental of public shooting grounds that will prove attractive to birds breeding in the far north that formerly wintered in California.

Funds for carrying out this program

will be forthcoming for the next five years and will amount to one-third of the increased hunting license fee annually. It is very probable that the committee will map out their whole plan of action for the entire five-year period before making an outlay of much of this fund. The purpose of such a step will be to avoid hasty investments which may prove to be sadly out of harmony with the ultimate objects desired.

SENTIMENT AND FORCE

Experience has proved that the vicious and law-breaking elements of society can be little influenced by sentiment. They are not moved by appeals for the protection of wild life because of its aesthetic value and beauty or because of its value as living neighbors to man. Regardless of the dwindling numbers of game, regardless of its brave struggle to prevail where man has thrown out of adjustment the old natural order, this element still takes pride in being photographed with an automobile load of slaughtered game of mixed varieties. In spite of the widespread spirit of conservation and appreciation for living things, their mental horizon still extends no further than the meat value of game.

The strong arm of the law has been the only effective method so far discovered to curb the activities of these who know no conscience in killing game. Force is also necessary as a means of occasionally reminding those who stray from the path of law obedience under the belief that, like the Ten Commandments, the fish and game laws are not supposed to apply to them.

Fines and punishment, however, are not as appropriate, nor as far reaching, in the case of those whose habits of life are being formed. Plastic minds under the proper stimulation are open to enlightenment. Education, which aims to establish a fixed respect for the higher values of wild life, can accomplish more in saving youthful offenders from becoming habitual violators than any form of punishment.

It is gratifying to record that law enforcement officers of the division embrace every opportunity to win converts to the cause of conservation. A recent instance where a deputy successfully appealed to the benign influence of a court on behalf of two boys, shooting ducks out of season, occurred in Riverside County. Investigation showed that the juveniles were not "repeaters" and had never been in trouble before. Judge R. M. Aitchison, of Thermal, therefore, applied the remedy of an impressive lec-

ture and dismissed the youths with a "message of conservation ringing in their ears."

SOUTHERN VOLUNTEERS CONVENE

A convention, unique because it was the first gathering of its kind ever held, occurred in Los Angeles on November 17, 1928. Seventy-three of the volunteer protectors of fish and game who operate south of the Tehachapi attended.

The meeting was presided over by R. E. Jeffries, captain of the deputies in Los Angeles County. Captain of Patrol Walter Welch instructed the men on

Judge Wilbur McDill acted as toastmaster at the banquet which lent a happy termination to the convention. Lieutenant Governor H. L. Carnahan, Fish and Game Commissioner Reginald S. Fernald and the executive officer were the featured speakers of the evening. R. M. Grose, representing the volunteers of the San Francisco Bay district, gave a brief address.

The convention was pronounced a highly beneficial one. It gave renewed vigor and zeal to those who participated and kindled a fine spirit of healthy cooperation.



FIG. 21. An airplane view of some marshy area taken during air reconnaissance of northern California by Governor's Advisory Committee on Game Refuges and Public Shooting Grounds. September, 1928.

their status as fish and game enforcement officers and the proper discharge of their duties. President I. Zellerbach and Executive Officer Eugene D. Bennett made forceful addresses and impressed those present with the importance of real conservation and protection. Federal Game Warden George Tonkin told of the cooperation between federal and state officers, while Assistant Chief of Patrol Charles Bauder expressed his pleasure at being able to work with the volunteer forces, who devote their time to the work without compensation.

NEW ASSOCIATION URGES INTERNATIONAL AND INTERSTATE COMMISSION

Due to the similarity of many problems confronting conservationists of the three Pacific coast states and the western provinces of Canada, and because these California, the Oregon Game Protective Association and Washington State Sportsmen's Association can be more harmoniously dealt with when handled by an men's Association organized the Western

Fish and Game Association at Medford, Oregon, in September.

One of the most significant problems having an international character is that of salmon trolling along the Pacific coast. Investigations of the U. S. Bureau of Fisheries disclose that salmon range from San Francisco Bay to southeastern Alaska. Great numbers of these fish are taken by trollers before they have reached maturity and at a time in their development when they have little market value. All who have studied the problem agree that these fish should not be exploited for commercial purposes until they enter the fresh-water streams and are of greatest food value. Resolutions unanimously adopted by the association urge the passage of legislation, both interstate and international, which will control the activities of the salmon trollers.

Another problem affecting the conservation of wild life on the Pacific coast, but having interstate significance, is the development of hydroelectric projects on the major fishing streams. Hence, Oregon's water and fish bills, which are intended to regulate unrestricted encroachment of such projects, are endorsed by the association.

PASSAGE OF FEDERAL REFUGE BILL URGED BY LEADING CONSERVATIONISTS

Major L. W. T. Waller, Jr., is accredited with the unique saying that conservationists should unite and take the "rest" out of federal restoration. Fortunately, an unanimous agreement has now been reached and the most important conservation organizations are supporting the passage of the Federal Migratory Bird Refuge Bill. Practically all of the leading conservationists were agreed when the first Norbeck bill was introduced in congress six years ago that the migratory bird situation in America was indeed a grave one and that it could be best solved through federal action. There was also unanimity that time was of importance, and that the need for government action was immediate. But the methods by which the federal refuges were to be obtained and managed proved to be storm centers which developed controversies so violent that they shook the very foundations of the conservation movement.

The present Norbeck bill has been stripped of the odious and objectionable features and provides merely that the government shall purchase and maintain refuges for migratory birds. The provision for public shooting grounds, about which there was much disagreement, has

been left out. The cost of establishing the refuges and of maintaining them is to be met by direct congressional appropriations. Hence, there is to be no federal license tax of \$1 for those who hunt migratory game. An actual initial expense appropriation of \$50,000 is provided.

The new Norbeck bill passed the Senate in May, 1928, and is now pending in the national House of Representatives. To better effect its passage in the House, a resolution supporting the measure and urging its becoming a law was read during the convention of the International Association of Game, Fish and Conservation Commissioners, and the Western Association of State Game Commissioners, representing the official state game departments in twenty-eight states, held at Seattle, Washington. The resolution was unanimously adopted.

A further provision of this resolution embodied the creation of a "National Committee on Wild Life Legislation." Six members of this committee were to be appointed from the following organizations: International Association of Game, Fish and Conservation Commissioners; Western Association of State Game Commissioners; The American Forestry Association; American Game Protective Association; Isaak Walton League of America, and the National Association of Audubon Societies. Additional power was granted to the above committee to add to its numbers five additional members selected at large throughout the United States.

Besides the important duty of assisting in the passage of the Norbeck bill, this committee is to represent these several organizations in other congressional efforts that may be undertaken, looking for the further protection of our wild mammals and birds.

PAST AND PRESENT JUSTIFICATION FOR THE UTILIZATION OF WILD LIFE RESOURCES.

No natural resource has played a more romantic role in the development of the nation than the profusion of wild creatures which roamed the forests and plains of the American continent. Witness the part fur-bearing mammals had in the exploration of America. The rich abundance of these creatures was the marvel of the first white men to behold them. Their rapid exploitation lured men on through the trackless forests, across the limitless plains and over superb mountain systems. Due to the intense rivalry of the fur-trading companies, some of them amounting to im-

perial organizations, outposts of civilization were progressively thrown out into the wilderness and the wildest parts of the continent made known.

No natural resource has been more unjustly exploited. There is some justification in the destruction of forests when lumber products have served a useful function in improving the well-being of a people. The rapid use of mineral resources, the stored-up capital of centuries, can also be viewed with less alarm when consideration is had for the improvement and development, both in science and industry, which their exploitation has brought about.

But what justification, either economic or social, can be given to balance the loss of countless numbers of wild creatures wantonly destroyed? The first settlers killed game for food. They warded off starvation by dependence largely on the natural food the country supplied. It is quite true, further, that the presence of large game was incompatible with agricultural settlement and the pasturage of domestic stock.

Who can view, but with dismay, these records? Before the sale of deer hides was prohibited in California, one Trinity County hide hunter killed 2000 deer in one season for their hides, leaving the flesh to fatten coyotes. The books of two shipping firms at Redding show in 1880 a total of 38,000 deer hides, buck, doe and fawn, secured from hunters operating in Shasta, Trinity and Siskiyou counties. A report of an agent of the Fish and Game Commission shows that "during the open quail season for 1895-1896, 177,336 quail were sold in the open markets of Los Angeles and San Francisco alone." As late as 1910, market hunters disposed of 500,000 ducks in the San Francisco markets.

Killing game wholesale was a business with the market hunters. No advantage they could possibly gain was spared over the game they sought. Not satisfied with legitimate methods of slaughter, they killed deer at salt licks; "ground sluiced" quail at waterholes and springs, killing 40 to 60 birds at a shot; approached ducks from behind a trained bull, with a double-barreled number four gun, frequently killing 150 to 200 ducks at one time.

Manifestly as soon as the present social values of wild life resources gained their place in the rising sun of conservation, the wholesale utilization of the state's game resources as a mere food product fell rapidly from popular favor. It was unjust that a few should have a right to enrich themselves by extrava-

gant and wasteful consumption of a resource belonging to all the people. The market hunters and their highly effective methods of destruction were outlawed.

California today is a state made prosperous through the exploitation of the accumulated natural wealth of ages. Its population is growing rapidly, concentrating in cities and acquiring certain social ideals and physical comforts. To complement an unprecedented amount of material well-being is a large amount of leisure. Assuredly, wholesome means for the expenditure of these leisure periods can not be neglected. Outdoor recreation has been defined as "The most wholesome expression of leisure and a needful social force in the readjustments of American life to meet new conditions." Moreover, as stated by Herbert Hoover, it is a "fundamental need in American life and satisfies a fundamental desire to do something to escape the drabness of civilization."

Americans, and Californians in particular, turn naturally to the mountains and woods for their outdoor recreation. How barren and dead, indeed, would be the woodsy solitudes, the flowering meadows, the rock-strewn flats and the wind-swept balds, if they were ungraced by so much as a single sign of wild life to gladden the spirits and charm the eye. Without mountain sheep to animate the higher ranges, deer and bear, grouse and quail to enliven the forests and valleys and trout swimming lazily about in the lakes and streams, outdoor recreation in California would lack that fundamental power to infuse new life and vigor; that power to soothe and quiet "the restless pulse of care."

INTERSTATE HIGH DAM PREVENTS USE OF FISHWAY

An 85-foot dam on the Susquehanna River, resting on one side on Maryland soil and on the other on Pennsylvania soil, known as the Conowingo Dam, has been the center of much interest. The Conservation Department of Maryland, the Commissioner of Fisheries of Pennsylvania and the United States Bureau of Fisheries, after "innumerable conferences" have been unable to find any type of fishway which would prove adequate to guarantee the interests of the people. By agreement, the Conowingo Power Company has committed itself to pay \$4,000 to each state annually. This money is to be employed in the propagation of fishes by the respective states to offset the loss caused by the obstruction.

The *Maryland Conservationist*, in its fall issue for 1928, says further on this subject:

"The laws of Maryland for years have required persons damming any of the public waters to establish at least one adequate fish ladder on such dam for the purpose of providing free access for fish up and down stream at all times. This law was effective as long as small dams were built, but with the ever increasing height of dams in this state, some running from sixty to one hundred feet in height, it becomes impracticable to enforce this law, as it has been proved conclusively that no fish ladder has ever been designed which will take fish over dams of such height. The department has solicited the aid of the U. S. Bureau of Fisheries from time to time on this subject, but they have been unable up to the present time to recommend a fish ladder that is adequate for high dams.

"The fishway question is a very perplexing one to conservationists of all states, requiring careful study and planning in each case before unwise expenditures are made. The public feels that their God-given rights of fishing are being trespassed on by power companies and others who are damming the public waters, and claim that the erection of such dams destroy valuable fish resources which are essential for food and sport. * * *

"Mr. Henry O'Malley, the U. S. Commissioner of Fisheries, has written an excellent article on this subject, entitled, 'Giving the Fish a Lift,' which appears in the August number of *Outdoor America*. His article shows conclusively that the Bureau of Fisheries has been unable up to the present time to find any fishways which they could recommend for dams of from sixty to one hundred feet in height, and indeed there is no sound mechanical device for elevating fish over dams which are more than twenty-five feet in height."

THE USE OF FISH EGGS FOR BAIT

Elsewhere in these pages a plea is made for more "sportsmen" along our streams and less "fishermen." Due to the widening popularity of angling as a wholesome form of recreation, a greater fishing effort is being put forth every season. The Division of Fish and Game is attempting to meet these increasing demands and to keep California streams and lakes stocked with gamey fish. Its success in this program depends, in no small measure, upon the encouragement of the practice of those methods which insure greater fairness to all those who fish.

The Bureau of Fish Culture has advocated against the use of fish eggs for bait or for chumming fish into schools to facilitate their capture. Fish eggs are a natural food. Their employment often yields a substantial catch without the slightest use of skill or ingenuity.

Probably the greatest objection to the use of fish eggs is that they are invariably swallowed by the striking fish. If the fish is below the legal size and the hook extracted, the wound is, in the majority of cases, of such a nature that the fish has a very slender chance of continuing life when returned to the water. A fish caught on a fly is usually hooked in the mouth and is not injured seriously. Another important objection is that small, immature fish readily take a salmon egg, when they will not rise to a lure which appeals to the predacious instincts of a matured, large fish.

It should seem that the use of artificial lures, such as spoons, spinners, plugs and flies, as well as natural bait, like insects or worms, are sufficiently tempting. At least their use, coupled with a certain amount of skill and ingenuity, guarantees the enjoyment of that "indefinable pleasure" which comes as the reward of landing a big fish on light tackle. And is this not the very marrow of sportsmanship? Certain it is that the use of fish eggs constitutes a drain on an already well exploited natural resource and does not "assure more and better sport for everybody."

DIVERSITY OF FISHERIES AN AID TO CONSERVATION

The Thirtieth Biennial Report of the division reveals that the commercial fish catch of 1927 exceeds that of any year in the history of California's fisheries. The total amount of fresh fish caught in state waters, off the California coast and brought into the state during this year, was 486,499,672 pounds. For the year 1926 the total catch amounted to 394,707,016 pounds.

Such record catches as these are not exceeded by any other state. In fact, Alaska alone surpasses California in the volume of its catch. To offset any fear that the state's fishery resources might be in danger of being overfished, it is well to notice that these splendid records are in part due to the great diversity of California's fisheries. There are over sixty species of fish and shellfish of commercial importance in the state, thus allowing for a better balancing between competing species.

"From the viewpoint of conservation," writes N. B. Scofield in the Thirtieth

Biennial Report, "there is a great advantage in having diversified fisheries such as California's for the reason that the species of fish compete with each other, either for food or by actually devouring each other. Under natural conditions there exists more or less of a balance between these species so that if man comes in and concentrates his fishing efforts on only a few of the species, the check is removed from the unutilized varieties with the result that they will prosper at the expense of the kinds which are being fished for. In other words, the fisheries will stand the strain of fishing better if the commercial catch is made up of many species, instead of a few.

Another advantage our state derives from its diversified fisheries is the splendid assortment of fish and shellfish to be found in our markets at all seasons of the year. One of the things which makes a lasting impression on visitors to the state is the large number of sea food restaurants which serve such a variety of sea foods."

REFUGES EFFECTIVE IN PERPETUATING GAME

The place game refuges should play in game management was emphasized at the first meeting of the International Association of Game, Fish and Conservation Commissioners sixteen years ago. The recommendations urged at the time were reiterated at the last convention and are as follows:

"Inasmuch as game refuges afford the most effective means of protecting the scattered remnants of our native game, it is recommended that every state should have one or more state refuges. Commissioners and wardens should be given adequate authority to arrange for refuges on private or state lands, and to cooperate with the proper officers of the federal government in the establishment of such refuges on public lands not now utilized for other purposes.

At that time the state refuges in existence did not number more than twenty, of which the Superior Refuge in Minnesota was the largest. Montana had two good-sized refuges and Pennsylvania five. Three waterfowl refuges had just been established in Louisiana, through private initiative, and Idaho had one refuge. Beyond that there were practically none of consequence.

Now there are hundreds of refuges, state and federal. Nearly every state has from one to seventy-five or more of varying size, the total aggregating over 20,000,000 acres of land or over 30,000 square miles set aside by the states as sanctuary for wild creatures.

Federal game and bird refuges also number 125, including national parks, some of which, particularly in the national forests and national parks and Alaska, are extensive.

The establishment of game sanctuaries has been the most notable feature of the

development of wild life conservation methods during the past fifteen years and is now regarded as essential to any effective plan for the maintenance of the game supply."—Proceedings Twenty-first Convention of Game, Fish and Conservation Commissioners.

SLAUGHTER METHODS STILL EXIST

California has long been noted for goose hunting. Seven different species winter within the state. In the supply of geese, the state has a splendid natural resource. Yet practically no other game bird has received less attention. For many years, geese were hunted by a method known as bull hunting, the market hunter using an animal blind. Later, however, ducks were saved from this sort of destructive hunting, but geese were still so hunted.

It has only been in recent years that any protection whatsoever has been given geese. Years after there were bag limits on ducks, no limit was set on geese. Finally, with numbers greatly reduced, the federal government lessened the bag limit. The restrictions, however, have not satisfactorily handled the situation. In the Sacramento Valley, there are a number of licensed commercial clubs where organized destruction is practiced. The owner loads onto a truck about 250 wild geese decoys. These wing-clipped birds are placed in enclosures out in a field. A group of ten hunters, along with a professional, hide themselves in pits. A flock of geese is attracted and upon signal from the professional hunter, ten men rise from the pits and blaze away. Oftentimes every member of a flock falls victim to the barrage. No hunter knows whether he killed a particular goose or whether his near neighbor shot it. After sufficient geese have been killed to furnish each man with a bag limit of eight, firing is stopped and the geese are collected. The men who try out this sort of hunting are usually disgusted. They fail to see how sportsmanship is displayed.

The Division of Fish and Game has for several years been endeavoring to have the legislature pass a law prohibiting the use of live decoys in the hunting of geese, but in each instance the movement was blocked by the professional hunters of the Willows district.

There is grave danger in this sort of hunting from a conservation point of view. Suppose a flock of geese from the north is made up of a number of birds which come from one particular locality. Suppose these birds, having migrated together, keep the flock intact with but a few additional stragglers added. If

every goose in the flock is killed by fire from ten automatic guns, there are no breeders left to return to this locality in the north. There are always a few birds left in every flock to serve as breeders and furnish birds for another year, when wholesale methods are not used and the hunter is thrown on his individual skill and ingenuity.

There is growing sentiment to the effect that this sort of organized slaughter must be stopped in California, if we expect to save a noted resource of our state. Undoubtedly a strenuous endeavor will be made to correct the situation during the present session of the legislature.

COTTONWOOD LAKES CLOSED TO ANGLING

The future of angling in California from a fishcultural standpoint is based on the ability of the division to retain a supply of spawn-bearing fish. Excessive fishing in certain localities readily accessible to densely populated areas has served to lessen the numbers of adult or egg-producing game fish, while contamination of natural spawning grounds in such areas has produced very unfortunate conditions. Physical factors beyond the power of the division to control have also entered in. For the last two years, seasonal floods have washed out racks at egg-taking stations and seriously cut down the number of eggs the division has been able to take.

The power of the Commission to close streams or lakes to angling has been exercised already in one important instance to conserve the breeding stock of a valuable and beautiful fish, the golden trout. The Cottonwood lakes in the High Sierra have developed into an exceptional spawning ground for this fish, yielding an average of 450,000 eggs a year. Golden trout thrive in lakes of high altitude where the water is clear and cold. Because this important spawning ground can be made to serve as the source of supplying High Sierra lakes with golden trout hatched and developed at the Mt. Whitney Hatchery, it has been closed to angling. It is predicted that since anglers are now deprived of the privilege of fishing in the Cottonwood lakes, the yearly egg take will show a decided improvement.

GAME AND FORESTRY

Successful examples are becoming less rare where owners of wild forest lands are managing their estates so as to obtain an additional profit from a by-product of their forests, namely, game. The advance of the science of game management,

coupled with the desire of land owners to develop the full producing powers of their properties, may be considered the foremost factors that have brought about the increase of such projects.

The November issue of *American Forests and Forest Life* contains an article by William T. Cox proving the worth of a joint commercial undertaking which gave due importance to the raising of game on land producing timber wealth. Actual profits derived from harvesting the fur and game crop off 30,000 acres embraced in Itasca Park and Forest reveal a yield of 66½ cents an acre a year gross. Supported by these figures, the author ventures to assert that a profit of at least 50 cents an acre could be derived from any area comparable to Itasca Park and Forest.

"There are in Minnesota alone," he goes on to state, "approximately 18,000,000 acres comparable in character and in fur and game carrying capacity to Itasca Park. If this immense area of woodland and lake, marsh and stream were allowed to become fairly well stocked with game and fur-bearing animals, the revenue derived from these sources, not to mention the timber and the fish, would be not less than \$9,000,000 a year. The fur crop in the forests of Minnesota, if given a fair chance, would pay the entire cost of thoroughgoing fire and game protection and leave a handsome revenue besides. The various forms of wild life probably give to water areas a value acre for acre just as great as that possessed by ordinary farm land. Muskrat lands in extensive holdings bring about 50 cents an acre profit. Commercial fishing over large areas of lake and river show about the same return. But most important of all, let us bear in mind that the game, the fish and the beaver, especially, have a recreational or attraction value less definite perhaps, but none the less real and probably greater, than their utilitarian value."

AERIAL SURVEY OF WATERFOWL CONDITIONS

Probably the most unique feature thus far of the survey being made by the Governor's Advisory Committee on Game Refuges and Public Shooting Grounds has been the attempt of the committee to gain a comprehensive grasp of the waterfowl situation by means of airplane flights. Indeed, what is believed to be the first extensive air reconnaissance of any migratory bird area occurred on September 29, 1928. The Standard Oil Company of California placed at the

committee's disposal its trimotored passenger monoplane.

In a comparatively short time the big monoplane, taking a southward course, flew over the Suisun marshes, the Sacramento delta and the important water areas of the Sacramento Valley. Some 400 miles were covered and great numbers of waterfowl were seen. Water was most plentiful in the vicinity of Willows, Colusa County, while the Suisun marshes seemed to be suffering mostly from lack of it.

It is proposed that later flights will be made to survey other portions of the state.

SMALL GAME REFUGES EXPRESSIONS OF CONSTRUCTIVE EFFORT

The average sportsman cheerfully expends as much as \$10 to \$20, and sometimes more, to enjoy a good quail hunt. Curiously enough, he resents any project whose object is to induce him to reach into his pocket and subscribe a small sum for quail preservation. His attention will most times be attracted by descriptions of the old-time abundance of quail. He will even agree that no opportunity should be overlooked to bring the little "plumed knight" back to their former numbers so that they can prevail everywhere again. When pressed, however, to subscribe money; when told that it is his duty to make a return for the birds he has bagged, he will be, indeed, above the average sportsman if he elects to accept such a burden.

Happily a movement is about to be set on foot by the San Diego Fish and Game Protective Association to acquire a fund to be used for the purpose of leasing a desirable plot of quail land for a long term of years. The plan embodies the building of a gamekeeper's house and the hiring of a man to patrol the refuge. The refuge is to be stocked with birds trapped in a few areas where quail are now common.

The small refuge represents a scope of activity logically within the domain of local sportsmen's associations. Once established and serving as a means of perpetuating a certain nucleus of seed stock producing a continuous supply for adjacent covers, the small refuge would stand as a splendid testimony that local sportsmen had entered actively into the practical business of wild life protection. The refuge would not alone be a source of local pride, but would also satisfy its creators that their collective money was being devoted towards constructive ends.

Let it be hoped that sportsmen everywhere in California will see this light;

that they will be willing to subscribe to the success of such projects so that they themselves may reap where they have sown.

THE MOST MODERN OF VIOLATORS

The Alaska Guides Association has gone on record as opposed to the use of aeroplanes by hunters to reach remote hunting grounds. They complain that the use of such means of conveying hunters readily to areas almost inaccessible by other means constitutes a serious menace. It permits molestation of some of the most valuable breeding grounds for Alaskan big game and makes law violation easy.

California has recently experienced something of the threat which the use of aeroplanes manifests toward the future of conservation. While the game refuge survey crew were posting and surveying Game Refuge 1-Q, an aeroplane was observed to land miles away in the middle of the refuge. The place was not readily accessible by road and could be reached only after a considerable journey. Afterwards, it was learned that the occupants of the aeroplane enjoyed a fine sage hen shoot and had winged their way back home, having violated the sanctity of the refuge with complete safety and freedom from apprehension.

STATISTICAL REPORT ON FRESH AND CANNED PRODUCTS FOR 1927

Illuminating facts showing that canned, smoked and dried fish valued at \$23,348,516 was produced by canners and packers in California during 1927 are contained in Circular No. 2, released for general distribution to all who desire this information, by the Commercial Fishery Bureau.

The circular mentioned, one of the most complete ever published by the division, also contains a complete record of the catch for 1927, with detail showing the various kinds of fish taken as well as a complete report of the sardine canners' operations during the period.

Packing plants numbering 75, valued at \$8,606,383 and employing 6461 people, handled the heavy pack of seafood specified in the report. Sardines as usual headed the list, six types of pack resulting in the production of 2,625,412 cases, while abalone scored the least with but 1987 cases being packed.

In the San Pedro district the highest canning record was made with 1,916,422 cases being packed, while Monterey came second with 1,398,762 cases. The total number of cases of canned fish is given as 3,882,900. Dried and smoked fish

included anchovies, Bismarck herring, mackerel, rollmop, sablefish, salacchini, salmon, sardines, shad, shrimps and squid. Squid leads in this class with 1,200,000 pounds being turned out at Monterey. Salted sardines follow with 110,770 pounds. Mild cured salmon numbered 2052 tierces, and smoked salmon totaled 66,805 pounds.

In addition to the products mentioned, 263 tons of fish flour, 21,111 tons of fish meal and 2,618,490 gallons of fish oil were turned out in the by-product plants operated by the cannery and packers.

GAME BIRD FARMING IN CALIFORNIA

Records of licensed game breeders show an increase to 201 issued in 1927

of public interest and a desire on the part of many people to assist in the work of propagation.

Many of the private breeders tell me that people who apply to them for game bird eggs for hatching make it known that they desire to rear these birds for liberation. This is a line of work that the Fish and Game Commission can well afford to encourage. It has been said that any poacher who can be induced to rear a brood of either pheasants or quail will never again follow this nefarious practice.

It requires no stretch of the imagination to suppose that by a very little work, 100 people in different sections of the state might be induced to rear 100 broods of birds. This would equal the



FIG. 22. Banding sick ducks prior to placing them in recovery pen for observation. Hollywood Gun Club, Kern County, California. October, 1928. Photograph by E. S. Cheney.

from 164 licenses issued in 1926. This means that 37 more people took out game farming permits in 1927 than in the previous year. This is a gain of 22½ per cent. While it is not large, it nevertheless shows the trend of a healthy growth. The figures for the year 1928 are not available, but it is the opinion of the writer, based on inquiries received at the Yountville Game Farm, that this percentage figure will be raised considerably. This is as it should be, for these figures give a very accurate cross-section

output of a very large game farm and the cost to the division would be very much less. The necessary element in a program of this kind is the right sort of information.

In the state of Washington, the writer well remembers one year when many thousands of eggs were sent to various individuals and organizations. Most anyone could get them who would apply. The weak point in that program was the fact that insufficient information was furnished to enable the one who received

the eggs to hatch and rear the birds properly. The average man and woman on the farm can do this work, if they are shown, or if the proper kind of information is furnished them.

This last season, a prominent man of San Francisco, who has a large country place, applied to the farm for birds for liberation. I asked him why he did not rear his own birds. He replied, "he did not know how." He was informed that we would gladly cooperate with him if he would send his attendant here so that we could give him first-hand information on just how the work was carried on. This request was complied with and the man was sent to the farm.

This attendant received 400 Chinese ring-necked pheasant eggs about the middle of May. The first of September a friend, who had been spending his vacation at this ranch, informed me that he counted 199 fine pheasants around the place. The attendant who looked after the pheasant rearing had never raised a game bird before. This was his first attempt, and it was a success.

In this work, like many other lines, a proper understanding of the requirements of game birds is the thing that counts. Often, at the request of a game breeder, when giving advice or trying to untangle some difficulty that has arisen, I am impressed by this fact. It would be a fine thing if those who start to raise game birds would first familiarize themselves with the general environment necessary for the comfort of the birds they intend to place in confinement. Fully 90 per cent of the cases where help is requested, the trouble hinges on the problem of insufficient room, and the lack of, or too much, sunlight.

Not long ago, I took some quail from a person who had them confined under a porch on a concrete floor. The sun had little chance to reach them. They never had so much as a single opportunity to get a dirt bath or dust themselves. This was just as important to them as a water bath is to a human. Birds and animals can not be confined in small enclosures for any length of time without bad results. Very few people know the real habits of the birds and animals they have in confinement, yet they expect them to get along. It is one of the finest tributes to the gameness of these creatures that they do as well as they do.

In a lecture before a parent-teacher association, Judge Ben Lindsey remarked that "the boys and girls who loved animals and birds" never came into his Denver Juvenile Court. In fostering this very important line of work it may be

possible that we will also be contributing something to the much talked about "youthful delinquency."—AUGUST BADE, Yountville, Cal.

LOCAL HUNTERS MOST SUCCESSFUL IN KILLING DEER

Facts and figures gathered from the deer tags turned in by hunters to the division for the season recently closed clearly prove that a man must have a better chance to kill a deer in his own county than an outside seeker of big game. A careful analysis of the residence of the hunters who killed deer this year and the place where the buck fell, shows that a man is much more efficient when working in his own territory.

There are exceptions to this in a few counties only, but in the counties where heavy kills were recorded the "home boys" bagged the most deer.

In Siskiyou County, where a grand total of 1654 deer tops the list for the state, residents of the county killed 983 bucks. While Los Angeles County hunters shot the most deer throughout the state during the season, of the 369 killed in Los Angeles, 320 were brought down by those who claim Los Angeles County as their home.

Alpine is an exception. Alpine County hunters bagged but 12 of the 66 bucks killed. The local lads fell down also in Mono County, getting only 23 of the 552 killed.

Of the 263 killed in Alameda County, residents were responsible for 197, while in San Diego the hunters in the southern boundary county shot 190 of the 232 that were checked out this year.

Residents of Del Norte County killed 54 deer. Despite the fact that only 48 were killed in the county, local hunters shot 45 of these, which shows considerable prowess in the seeking of big game.

HOLDING PONDS

Various fish and game protective associations have been aiding in fish distribution by building holding ponds. The Tulare Association, by securing the cooperation of various clubs, has to their credit, three holding stations as follows: Kernville, 7 ponds, 10'x80'; Nelsons, 3 ponds, 10'x50'; Mineral King, 4 ponds, 10'x50'. An attendant has been employed to feed and properly care for the fish at each station. The ponds are so arranged that they can be cleaned and the water held at any particular level. The eastern brook trout held in some of these ponds attained splendid size before the volunteer packers took them into the back country and planted them.

Those responsible for these holding ponds maintain that the advantages gained are:

1. Fish planted at the most ideal time of year for the locality; not the time when water is lowest in the streams.
2. Early growth is in natural environment and under controlled conditions, enabling the weaker fish to become more vigorous before planting. Hence a sturdier stock is planted.

DEER HERDS ON INCREASE

A report issued by the Washington office of the Forest Service in November states that deer throughout the national forests of the west are increasing. In a few places, they have multiplied in numbers beyond the ability of the locality to sustain them. Protected by man and not destroyed by lions, wolves, coyotes and lynx, because these predators have been removed by predatory animal control measures, many of them face starvation or disease from the weakening effects of lack of food.

It is clear that in such cases where deer multiply beyond their means of sustenance, conditions have been allowed to obtain which overreach the ultimate object of the conservation of the species in question. There is need for measures to be taken to stabilize conditions surrounding the welfare of such animals. Why not a plan of management which will permit killing by hunters up to the point of taking each year what would amount to the annual increase? A given locality is capable under normal conditions of producing a certain amount of food for deer. The deer population should be kept stationary in the sense that it should never be allowed to exceed the maximum number of animals the locality is able to feed. Less cruelty to the animals will be effected by such a plan than if their numbers are reduced by starvation and disease.

THE MYSTERY OF GAME WARDENS

Many unthinking people have come to believe that there is something mysterious and awful about game wardens. It is the duty of every deputy of the division to make an earnest endeavor to break down this somewhat popular superstition, and to have the people and the sportsmen feel that game wardens are their friends and that in their efforts to protect and conserve the supply of wild life within the state they are working in and for their best interests.

The best game warden in the world is a human being—neither half devil nor half god—but just a man. A good game

warden must be quick to think, keen to analyze, persistent, resourceful and courageous. As a matter of fact the work of game wardens is just plain business, like any other business, and in order to be successful must be undertaken and conducted in a businesslike manner.

However, the game warden's business is full of vexations. There are times when the warden knows to a certainty that the fish and game laws are being violated and the identity of the violator, yet arrest must wait until evidence of a positive nature is at hand; but sometimes the evidence never comes. If there is mystery attached to the movements of game wardens it is simply because, in order to be successful in their work, secrecy is imperative.

These are some, but not all, of the troubles met by game wardens. If the warden is "spineless" he is sure to be inactive and lax in the discharge of his duties and soon becomes a liability instead of an asset to the cause of wild life protection and conservation. The game warden who is energetic, honest and faithful to his duties, persevering and courageous, will keep the fish and game law violators a-guessing, and will catch the boldest and the shrewdest of them in the end.—WALTER R. WELCH.

RAINBOW TROUT IN NEW ZEALAND

Further indication of the popularity and success of the American rainbow trout in foreign waters is contained in a consular report from New Zealand, which states that the stock of this fish introduced in the Tongariro River has yielded over 4,000,000 eggs. Most of these eggs were incubated in the hatchery operated by the New Zealand department of internal affairs, some were sent to the fisheries department at New South Wales, a small number was sent to Tasmania, and a few were distributed to local acclimatization societies, which are similar to sportsmen's associations in this country.

That the New Zealand authorities are acquainted with the latest developments in fishcultural work is indicated by the fact that they are undertaking the planting of food organisms in waters that have been stocked with rainbow trout. Four hundred and twenty-six thousand freshwater shrimp were planted in Lake Taupo, and plans are being made to transplant small indigenous fishes from other waters to this lake. It is stated that the work is being done with the idea of insuring a food supply sufficient for the future needs of the lake.—Fisheries Service Bulletin, Bureau of Fisheries, No. 162, p. 1.

GAME REFUGE 1-Q

Of all the game sanctuaries in the state, Refuge 1-Q is the most interesting as to the number of species of game sheltered. Located in the eastern part of Lassen County, it borders on a similar refuge in Nevada. There is very little timber; in fact, the game survey crew had to carry their own posts for signs. Within the boundaries are located more species of game than in any other similar area. Probably the only white-tail deer in the state range in the sagebrush along with hundreds of antelope.

On one of the higher and rougher elevations is a small band of mountain

the fish hatcheries. In this field relatively little study and investigation has been conducted in the United States. Needless to say that past experiences demand a systematic and scientific program that will attack the difficulties encountered in the hatching of eggs and raising of fish. With the present knowledge of fish diseases in this state one is largely dependent on analogy, deductions drawn from an analysis of the literature.

In Europe many fish diseases have been recognized. An excellent summary may be found in "Praktikum der Fischkrankheiten," by Plehn. The number of investigations in this country has been



FIG. 23. Boy Scouts of State Conservation Training Camp having a personal experience with a mule deer, Yosemite, California, August, 1928. Photo-by B. C. Cain.

sheep, the only band in northern California. Sagehen may be counted by the hundreds. Mule deer are abundant and quail are not uncommon. There are numerous places where waterfowl find adaptable nesting places.—J. S. HUNTER.

FISH DISEASES

The time is here when the fish hatcheries will soon be in full operation again in the hatching of trout eggs and the rearing of fingerlings. Those concerned with fish culture turn their thoughts toward what problems they may anticipate and guard against. Fish diseases play a prominent role among the problems of

small, and consequently very few publications are available.

During the past year in the months of June and July several outbreaks of disease in the different hatcheries have come to the attention of the laboratory. Two hatcheries experienced disastrous mortalities in one instance due to a severe epizootic (furunculosis) which killed the entire stock, and in the other an unknown factor reduced the fish to 50 per cent. In another holding pond a mold infection was reported to have caused a 100 per cent mortality. Parasites and fungi also caused trouble in a few instances. These brief reports clearly indicate that fatal fish

diseases do occur in California. It is obviously the duty of the laboratory to institute measures to prevent these losses. Not all the diseases are due to parasites. Some factors, such as too high temperatures, poor aeration of water, improper and contaminated food, and polluted water acted as predisposing and probably also as contributory causes.

Whenever abnormal conditions are observed in the fish or their environment, immediate action should be taken to determine the nature and cause of the trouble. Only affective treatments should be applied to troubles of which the cause is known. In the past, in certain outbreaks where remedial agents failed, the fish were dumped into the streams where natural environment might be more suitable. This was carried out as the last resort to save them. From an epidemiological point of view, such a practice is exceedingly dangerous, since it encourages the dissemination of infectious or communicable diseases. It should be appreciated that prevention is always less costly than treatment and the institution of control measures when an epizootic is once on its way.—H. VAN ROEKEL.

NEW GAME FARM FOR CATALINA ISLAND

A large game farm has been established near Avalon, on Catalina Island. It is under the supervision of Mr. Lewis, who formerly was assistant at the State Game Farm at Yountville. One hundred thirty large breeding and rearing pens have been built. A red tile roofed wall encircles the entire grounds which are surrounded by landscape gardens. A very large flight aviary built of steel and including a large circular pool for waterfowl has also been erected. Many varieties of pheasants and quail, together with many showy tropical birds, are on exhibition. Mr. Wrigley is sparing no expense in making the Catalina Bird Farm one of the greatest avicultural exhibits in the country. Special emphasis is to be laid on the propagation of game birds heretofore found difficult to rear in captivity.

DESTRUCTION OF UNDESIRABLE FISH

A number of states are endeavoring to improve fishing conditions by eliminating undesirable or rough fish. Minnesota has been active in this sort of work. Within the past few months, California has attempted the destruction of undesirable fish in Clear Lake.

An interesting article by J. G. Burr, which appeared in *Field and Stream* for

November, 1928, reports that a unique method has recently been tried out in Texas. The idea of using a strong electric current was obtained from reports of fish farming in Germany, where undesirable fish are removed in this way. A current of 332 to 350 volts was used and suckers and carp were stunned and rose to the surface. Men in boats with dip nets removed these fish from the water. Bass and perch were allowed to recover and swim away.

KLAMATH FISHING ACCORDED HIGH PRAISE

When the steelhead fishing is at its best in the Klamath, it is doubtful if there is any stream in the United States that will hold more thrills for the trout fisherman than that California river. Fly fishing, spinner fishing, bait fishing, all yield sport, and when the fresh run fish of several pounds in weight strike, the fortunate angler is in for a battle. There are many streams, some in the west, but mostly in the east and along the east coast, that are better known and more fished. But fishermen who have wandered along such waters as the Nipigon, the Beaverville, the Neversink, the Gunnison and even the Madison, say that there is nothing to surpass the Klamath in any of them.—*The American Field*, Sept. 29, 1928.

HUNTING ETHICS

Many outdoor writers devote columns to such matters as where to hunt, how to bag game and the kind of equipment to use. Such basically essential problems as perpetuating and increasing the game supply, improving the relations between farmers and sportsmen, and saving human life are items which are invariably neglected.

The Izaak Walton League believes that clean sportsmanship, an even break for both the hunter and the hunted, constant vigilance to prevent accidents, and a square deal for the landowner, are matters which can not be stressed too forcefully. America needs more real sportsmen pulling together in a common cause. We need less of the "hoodlum" element.

Observance of the following suggestions will help perpetuate America's scheme of publicly-owned game and assure more and better sport for everybody:

1. A human life is worth more than all the game in America—see clearly before shooting.
2. Carelessness with firearms is criminal—play safe and avoid accidents.
3. Healthful recreation and the thrill of the chase are a true sportsman's prime objectives always.

4. Observance of the law and eradication of the game hog are responsibilities no sportsman can evade.

5. A few fools with matches kill more game than many shotguns—prevent fires.

6. Only vandals destroy farmers' fences, injure their stock or disregard their wishes.

7. Real sportsmen never try their skill about farmyards, pastures and on trespass signs.

8. Saving ample seed stock, and feeding it during the winter time, will perpetuate the sport.

9. A clear conscience at the end of the trip and an invitation to come again beats

bands on the legs of our native birds, an important investigation is being carried on by our Government. The purpose of this investigation is to learn how long birds live, what routes they travel in migration, how many miles they travel in a day, whether or not they return to the same locality, whether or not they keep the same mates and many other interesting questions. If you handle any game bird or find any other kind of bird, dead or alive, examine its legs for a band and read the number very carefully. If the bird is alive, leave the band on and release the bird, but if the bird is dead, remove the band and send the band and all infor-



FIG. 24. State Conservation Training Camp for Eagle Scouts. Yosemite, California. August 5-15, 1928. Photograph by B. C. Cain.

a full bag.—SETH E. GORDON, Conservation Director, Izaak Walton League of America.

SPORTSMEN REQUESTED TO REPORT BANDED BIRDS

The United States Bureau of Biological Survey wishes to stir greater interest on the part of hunters in banded birds. The knowledge to be gained through reports of such birds killed by sportsmen is fundamental to an understanding of their travels. The following is an announcement explaining the reasons for such work:

"By means of numbered aluminum

information possible in either case to the Biological Survey, Washington, D. C. More volunteers to place these bands on birds are needed. If you are interested, write to the Inland Bird Banding Association, William I. Lyon, president, 124 Washington street, Waukegan, Ill."

MOUNTAIN LION CONTROL

Bounties have been paid on mountain lions by the state since 1907. The yearly average during these 21 years has been 246 claims paid each year. Records from the Thirtieth Biennial Report disclose that during the past biennium the number of lions killed bordered on this yearly

average. The claims of lion killers over the entire state for 1926 amounted to 249 lions and for 1927, 241 lions.

It is believed that the total lion population in California is not greater than 500. This population is probably able to reproduce yearly not more than the number slain every year by hunters. In other words, control measures have been effective in that they have kept these large predators from increasing. The lion population has remained stationary. Further aggressiveness, making possible a greater yearly toll, would soon find the death rate in excess of the birth rate.

THE DEER SITUATION IN PENNSYLVANIA

Due to the considerable controversy in the state of Pennsylvania on the exact status of food for its wild life, and the belief entertained by the Pennsylvania Board of Game Commissioners that deer were "destroying not only food for themselves, but were also consuming natural food for small game," the commission "decided to get some well known authority from outside the state who could give an unbiased opinion, for the use of the public as well as the game commission."

Vernon Bailey, of the U. S. Bureau of Biological Survey was secured. Mr. Bailey's reports are given with indisputable data with which to substantiate them. He has been with the United States government service for forty years, with most of his time given over to conservation problems, especially with regard to food conditions.

Due to the soundness and value of this report, it is summarized in the following:

"The country examined lies mainly in Mifflin, Centro, Clearfield and Elk counties, and includes some of the best deer range in the state." The region is mountainous, being from 1800 to 2300 feet elevation. It is rugged and deeply eroded into narrow canyons and gulches with broad plateaus at the tops of the ridges. Except for cabins of rangers or hunters, the country is uninhabited; only in the lower valleys has the farmer encroached. It was heavily forested at one time, with white pine, hemlock and hardwoods. However, it has been cut or burned over many years ago. Now forested in second growth hardwoods, such as oak, chestnut, maple, birch, aspen, alder, black cherry, pin cherry, beech and scattered conifers such as white pine, red pine, scrub pine, and hemlock and a great variety of shrubby vegetation.

The life zone is Transition, but on the highest, coldest slopes there is a trace of

Canadian. In the lower valleys there is a strong element of the Carolinian zone.

"The chestnut trees, which at one time formed a large part, possibly, one-half, of the forest timber, have all died with the chestnut blight, but young sprouts are still coming up around the base of the trees and these sprouts furnish much browse for the deer." The former crop of chestnuts are not now available for deer food. The oaks are large enough now to furnish some food in the form of acorns for deer.

Deer were reduced in 1907 to a very low number, but at that time they were given better protection. The hunting of deer with dogs had been prohibited in 1905. Deer were imported from Michigan, Vermont and Kentucky for the purpose of restocking the depleted range. In 1907 the buck law went into effect, allowing the killing of bucks with visible antlers. This law was modified in relation to length of horns and in 1925 only those bucks with two-point antlers or greater could be killed. No does had been legally killed for 21 years except in 1923 to 1926, when a limited open season on does was allowed in certain townships where they were too numerous. However, in the four years only 2400 does were killed in the state. In 1913 there were only 800 bucks killed, while in 1927, through a steady increase, 15,000 bucks were killed.

There are 45,000 bucks over two years old in the state at this time, according to estimates. It is also estimated that there are 25 does to one buck so that would indicate over 1,000,000 does in the state. Only one fawn to every 10 does is the estimated increase made by game protectors.

All the live deer seen during the investigation were does, while only one last year's fawn was noted.

Mr. Bailey said he had never seen deer feeding on such a variety of vegetation. These varieties were listed in his report. Five deer in an enclosure near Lewiston were evidently hungry for green foods as they eagerly ate dandelions, wild lettuce, mandrake, plantain, poison oak, clover and grass. These were gathered from outside and fed to them. A heavy growth of skunk cabbage in their enclosure was untouched. "The stomach of one buck which had been killed in December and had lain on the ground through the winter was dried up and preserved." It contained a mass of masticated plant fibres, bark, buds, leaves, and other woody material. A yearling fawn stomach contained buds, leaves, twigs, and a large amount of white pine leaves. Another contained leaves, twigs and bark with a few laurel leaves.

A two-year-old doe found dead where there was an abundance of laurel contained a large amount of these leaves which made up one-half of the stomach contents. Very few farm crops go unattacked by deer.

The upper limit of browsing of deer is clearly defined and conspicuous where deer are abundant. This is known as the "deer line." It averaged about six feet from the ground where deer are congregated, but only four or five feet where it is less heavily browsed. The "deer line" is the extreme height to which the large animals can reach, while standing on their hind feet. Where the slopes have been grazed to a height of six feet by the large deer, the fawns and yearlings can not reach the lowest branches and are thus deprived of the best food. This is an apparent cause of the recent loss of large numbers of last year's fawns.

During February and March of the past winter, an unusual number of deer died. Most of these were last year's fawns; only two out of 250 carcasses were two-year-old deer. It was estimated that there were 1000 dead fawns in four townships.

The old deer seen were generally thin, but active and apparently in good health at the time. "No bucks were seen that could be recognized as such and only a few of the does that were seen at close range showed signs of carrying fawns." The fawns died because of their handicap in procuring food which was out of their reach.

Poisoning by laurel was kept in mind, but no evidence of such poisoning was secured. Much laurel and rhododendron had been eaten by both young and old deer, so that the shrubs were being rapidly killed out. "If seriously poisonous, the plant would have been avoided, but otherwise would have killed others as well as the fawns." The whole trouble is from overstocking the range with deer.

The deer have done great damage to young trees, planted in a reforestation program. Only the deer-proof fences have proved a safety measure. Norway, white and Scotch pines, European larch, Norway spruce and a few hardwoods have all met a similar fate.

"The destruction of crops at the edges of farms is also a serious problem and has given much trouble to the game commission." The commission furnishes wire and staples and the farmers build the fence in order to keep out the deer. This can only be done on a limited scale, however.

Deer have destroyed much of the cover and food required by grouse, pheasants,

turkeys, quail, rabbits and other small game.

Some of the suggested improvements are that there should be an open season on does which, besides reducing their numbers, would scatter them over a much larger area and make them wild again. This would prevent massing in favorite spots with the consequent loss by starvation. There should be at least one buck to three does. Their numbers should be kept well balanced from year to year.

Only one sex at a time should be hunted because of danger to hunters when no restrictions on sex are made, and the hunters shoot at anything.

Scattering the deer with small barking dogs in early winter would help to equalize the distribution and avoid danger of starvation. Game protectors say that all deer ranges are overstocked with does, however, and only a reduction of their numbers will relieve the situation.

Improvement of food conditions could be accomplished on the open unforested lands, where perennial plants for deer food could be introduced. It might be possible to introduce the chinquapin to take the place of the chestnut. It is a member of the chestnut family, but not effected by the chestnut blight. Various species of small oaks that produce abundant acorn crops are also possible. Some of these would grow where now vegetation is scarce or killed off. Replanting, however, is slow and expensive.

"Study of this particular instance of loss among deer indicates clearly and forcibly the practical necessity of delegating to game commissions large discretionary powers in administering game resources so that action may be taken promptly as specific conditions may require and to make possible effective introduction and use of up-to-date management practices based on sound knowledge of the habits and requirements of the animals and of conditions affecting them."—D. D. McLEAN.

SOME FACTS ABOUT FISH

The smallest known fish is the tiny Goby of Philippine waters. Average adult length is about one-half inch.

The largest known fish are perhaps the Basking Shark of sub-Arctic waters, and the Carchardon of the tropical waters near Australia and New Zealand. They both grow to a length of about 45 feet.

The most extraordinary fish is the Vampire Ray of the West Indian waters. It reaches a width of about 25 feet across the wings.

The most remarkable fish is the Regalecus or "King of the Herrings," of the

littoral waters of northern Europe. It grows to about 20 to 25 feet in length, about 4 inches wide and about a foot high or deep.—*Montana Wild Life*, October, 1928.

SPORTSMEN'S CLUBS AND THE LAW

As the wealth of the country increases the tendency for men of means to buy large hunting and fishing preserves for their exclusive use is growing at an alarm-

on an adjacent territory. Unfortunately, however, some clubs still persist in condoning practices which are unsportsmanlike, illegal and unfair. The effect is most deplorable.

How can Mr. Average Citizen be expected to obey the law when reputable citizens of high standing tolerate violations and make game hogs of themselves?

The board of directors of a well known Mississippi Valley club last fall issued a



FIG. 25. Three and four-inch fingerlings, Rainbow trout. Kings River Hatchery, Fresno County, California. September, 1928. Photograph by Kenneth Shebley.

ing pace. And if the general public will not take time by the forelock and provide public lands for these purposes, certainly individuals can not be criticized for protecting themselves.

The majority of these clubs are composed of clean, upstanding sportsmen. Many of them protect, feed and stock game and fish on a much more intensive scale than is done by the general public

warning to all its members in the following language:

"Our attention has been called to the necessity for a more strict observance of the federal and state game laws, especially those pertaining to the daily bag limits and sunrise and sunset restrictions. To preserve our good standing, and the respect and morale of our employees and neighboring clubs, it is essential that this

be done. Members who deliberately violate these restrictions will be reported to the authorities."

More clubs should be doing the same thing, then follow it up with real action—not just a bluff. How about your club?—*Outdoor America*, December, 1928.

SOME RETURNS FROM CALIFORNIA BANDED BIRDS

Leo K. Wilson, writing in the *San Francisco Chronicle* for November 30, 1928, makes the following interesting report on flights made by some California banded birds:

"During the last few days of the open season on ducks and geese last year, and during the first few weeks in February of 1928, A. D. Trempe of Sault Ste. Marie, Michigan, and H. P. Gray of Piedmont, California, carried on considerable work in banding ducks, geese and other waterfowl on the various shooting preserves in the Los Banos and Gustine regions. According to a recent report from Mr. Trempe, many of the birds so banded have already been picked up by shooters. Since several of the records were of geese and mudhens, they may be of interest to other sportsmen.

Of the geese banded at the Gustine Gun Club on February 2, 1928, three have been reported as killed. Len Hawxhurst, well known local trapshooter, killed one of them at Gustine on October 1, and on the same day J. Armstrong killed one at Byron. On October 7, 1928, J. E. Doan killed the third at Gustine. Apparently the white-fronted geese return to the same winter feeding grounds after the summer breeding season in the north.

The records of mudhens are particularly interesting. Not infrequently one hears duck shooters discussing the migration of these birds. Because of their clumsy flight, it is thought by many shooters that their migrations are quite limited. However, mudhens banded at Gustine between the sixth and tenth of February, 1928, have been picked up by shooters as follows: One was found dead by H. Beaudry at Morinville, Alberta, on June 7, 1928. Another was killed at Walker Lake, Nevada, by an Indian, and was reported by E. W. Fronquist of the Indian Field Service. Another was found dead by N. D. Haylett at Eston, Saskatchewan, Canada. It seems strange that these two mudhens were found, while very few banded ducks are reported as "pickups." Perhaps someone shot them and left them where they fell."

RESOLUTIONS OF THE AMERICAN FISHERIES SOCIETY

The following resolutions were passed by the American Fisheries Society at its

fifty-eighth annual convention held in Seattle from September 28 to 31, 1928:

The American Fisheries Society approves the fish cultural policy of the U. S. Bureau of Fisheries and its program of biological and technological research along practical lines and urges the adoption by congress of the five-year program recommended by the committee on Merchant Marine and Fisheries at the last session of congress, providing for the extension of the work of the Bureau of Fisheries.

"In view of the growing menace to the fisheries through encroachments of hydro-electric developments on our streams, the American Fisheries Society urges that streams of real importance to the fisheries' resources be determined and designated without delay and that such streams be withdrawn from further power development until urgent public need for such development is clearly shown, and until a known method whereby anadromous fishes shall not be interrupted in their nuptial journey has been provided for without any doubt.

The American Fisheries Society strongly approves the efforts of the U. S. Bureau of Fisheries and the several states interested in the problem to devise an efficient method of preventing the enormous loss of fishes in irrigation ditches, and we urge that the efforts be continued until a satisfactory solution is found and applied.

It is also urged that sufficient appropriations be provided by congress for a similar investigation tending toward the solution of the fishway problem.

In view of the fact that many important fisheries in industrial districts have been destroyed by pollution of the waters; and that other important fisheries are in imminent danger from the same source; and that the state of Pennsylvania has adopted a very effective method of dealing with this problem, it is therefore urged by the American Fisheries Society that similar methods be adopted by other states.

It is also recommended that the establishment on unpolluted waters of industries having injurious wastes be delayed until satisfactory methods of handling such wastes can be applied.

The American Fisheries Society recognizes the existence of the various fisheries conservation problems common to the United States and Canada—in particular, of those relating to the salmon fisheries of the Great Lakes, and recommends the immediate adoption of appropriate treaties looking towards the restoration of such international fisheries as are depleted and the adoption of uniform regulations where such are desirable; and to a closer cooperation in dealing with such matters.

The American Fisheries Society approves the work accomplished by the Western Food and Game Fish Protective Association through the cooperation of sportsmen, commercial fishery operators and others interested in the preservation of the fisheries; and urges a closer cooperation between these various interests throughout the country in securing constructive action on fishery problems.

WHEREAS, There has been an increase of considerable proportion in commercial troll fishing in the Pacific Ocean off the coasts of Alaska, British Columbia, Oregon, Washington and California, during recent years; and

WHEREAS, There are numbers of immature salmon taken, especially during the early spring months; and

WHEREAS, This has resulted in a depletion of the salmon supply; and

WHEREAS, It is evident that in the interests of conservation and perpetuation of

a major industry that some remedial legislation is needed; now, therefore, be it

Resolved, By the American Fisheries Society, in convention assembled, at Seattle, Washington, this thirty-first day of August, 1928, that the several legislatures of California, Oregon and Washington, as to their respective coasts, the Department of Marine and Fisheries of Canada, as to the British Columbia coast, and the U. S. Department of Commerce, as to Alaska, be asked to pass uniform legislation or promulgate uniform orders, that will regulate commercial trolling, and the landing of troll-caught fish, by the establishment of closed season periods.—*Science*, November 9, 1928.

TULE LAKE BIRD REFUGE

By executive order, President Coolidge has created the Tule Lake bird refuge in northern California, thus bringing to 80 the number of wild-life reservations administered by the United States Bureau of Biological Survey. The new refuge consists of 10,300 acres of government lands in northeastern Siskiyou County, within the Klamath irrigation project. These lands are flooded to a considerable extent by waste water and thus form an excellent waterfowl resort.

Paul G. Redington, Chief of the Biological Survey, in commenting on the establishment of this project, states that this is a most important addition to the list of wild fowl refuges established by executive order and by acts of congress. Tule Lake has long been the mecca for such wildfowl as the mallard, redhead, ruddy duck, cinnamon teal, avocets, stilts, and other shore birds. It also is a favorite wintering ground for the cackling goose, a bird that breeds on the north-west coast of Alaska.

The layout of the area is such, due to mud conditions along the shores, that a natural refuge has existed in the northern part of the Tule Lake area, but sportsmen have in the past found their recreation on other portions of the area. In order not to mete out undue hardship to these sportsmen, it was deemed advisable to allow a continuance of hunting privileges in an area at the southern end of the lake, and accordingly the Secretary of Agriculture on October 10 approved an order permitting hunting on 2800 acres south of the line forming the north boundary at sections 33 and 34 of township 47 north, range 4 east, Mount Diablo meridian. The inviolate refuge, therefore, comprehends 7500 acres of land extremely valuable for resting and feeding grounds for the birds which frequent the area.

Mr. Redington further states that this refuge, which lies just south of the California-Oregon line, will supplement the Clear Lake refuge in California, just east of Tule Lake, and the recently established

Upper Klamath refuge, on the west shore of Klamath Lake, in Oregon. A year ago it was announced that because of lack of water a reflooding program on Lower Klamath Lake, west of Tule Lake, would have to be abandoned. The establishment of the refuge, therefore, on Tule Lake will in a measure offset the loss of possible sanctuary caused by the abandonment of the Lower Klamath project.

It is further stated that because of the encroachment of industrial and agricultural development the wild fowl have in many areas throughout the United States lost their former homes and stopping places, and that the government in its obligations under the Migratory Bird Treaty with Great Britain is steadily working for the reestablishment of suitable water areas so that the wild fowl may regain something of what they have lost. The setting aside of such areas strategically located along the principal lines of migration will probably do more for the future welfare of the wild fowl than any other one measure. Protective laws relating to seasons and bag limits are in effect and play their part in the conservation of ducks and geese, but these will be of little avail if they are not backed by the establishment of refuges such as the one just set aside.

NEED FOR GAME AND BIRD REFUGE STRESSED

In his report to Secretary of Agriculture Jardine on the work and accomplishments of the Bureau of Biological Survey for the year 1928, Paul G. Redington, chief of the bureau, places emphasis on wild-life research. He considers this fundamental to all other functions of the bureau and basic to the chief service expected by the public and by the various states. He also stresses the importance of the establishment of game and bird refuges as being without doubt the greatest single factor in successful wild life administration.

"The development of additional refuge areas for wild life," says Mr. Redington, "has been brought more intimately to public attention, and the sentiment throughout the country is more definitely crystallized in favor of a unified program, as it becomes generally understood that the onward march of civilization, with its farming and industrial operations, threatens, at least locally, the ultimate extinction of the various form of wild life that were the delight of our forbears and that can not be perpetuated for future enjoyment unless provided with ample range, including feeding, breeding, and resting grounds. There is urgent need for

funds to enable the Biological Survey to investigate and determine the suitability of areas that are being proposed for refuge purposes."

Mr. Redington mentions as outstanding among the accomplishments and new lines of work undertaken in research during the year, the following:

Inauguration of studies of the relative abundance of migratory wild fowl from year to year, through systematic and repeated censuses taken by cooperators on important waterfowl concentration areas.

Authorization by congressional act of more extended research having to do with the relations of wild life to forestry—the effects of birds, mammals, and other forms on forest production.

Successful crossbreeding of Alaskan reindeer with native caribou captured for the experiments, and the birth of fawns of materially increased weight.

Establishment of a Rabbit Experiment Station at Fontana, California, to supplement other investigations on the production of rabbits for fur and food, and progress in cooperative investigations of diseases of foxes and measures for their prevention and cure on fox farms.

Progress in research work on the food of the English sparrow, in studies of the requirements of the Wyoming elk, in the administration of other game animals and birds on reservations, and in coordination of state and federal policies in wild life administration generally.

Important measures mentioned for the welfare of wild life are the authorization by congress of a refuge for migratory birds in the extensive Bear River marshes, Utah, and first steps in its administration, as an aid to conserving the wildfowl resources of the west; and greater expedition in the work of acquiring lands for the Upper Mississippi River wild life refuge through congressional aid and through private donation of areas important to the purposes of the refuge.

Of importance to cooperative work for the control of wild animal pests of agriculture, horticulture, forestry, stock raising, and wild game was the development, through a conference of field leaders in rodent and predatory animal control at Ogden, Utah, of improved plans for research work and definite policies in local and general control operations. "Congress has requested," says Mr. Redington, "that there be submitted to it at the next session a plan that will operate to insure adequate control of the predatory animals throughout the country."

Seven federal conservation laws are listed that are administered by the Biological Survey, including the migratory bird treaty and Lacey acts, and, by cooperation with the Alaska Game Commission, the Alaska game law.

"Respect on the part of sportsmen and the public in general for federal and state laws for the conservation of wild life,"

says Mr. Redington, "is increasing from year to year, and United States district courts and district attorneys have continued their interest in the enforcement of the regulations. There are still too many hunters who will violate the law whenever opportunity is afforded. Demands for better enforcement of the federal migratory bird regulations are insistent and general. Citizens everywhere express their approval of the law but assert that enforcement is notably inadequate. The reason for this criticism becomes evident when it is realized that the appropriation available for enforcing the migratory bird treaty act regulations allows for the full-time employment of only 24 salaried game protectors throughout the entire country. Each game protector must on the average cover two states, and in his work can have little assistance from the United States deputy game wardens, since funds are not sufficient to permit many of these latter officials—generally voluntary cooperators—to be assigned to this duty. The establishment of an adequate force of game protectors would have immediate beneficial results in a quickening of public interest in wild life protection and in strengthening the public support of the migratory bird treaty act."

The regulations promulgated by Secretary Jardine for the protection of game and fur animals in Alaska, under the new law of 1925, are declared by Mr. Redington already to have shown their effectiveness in the conservation of the wild life resources of the territory.

"Alaska possesses many interesting and highly valuable forms of wild life," he continues, "that need more protection than is now afforded them through the limited resources available to the Alaska Game Commission. With fairly large numbers of such noted big game animals as the mountain sheep, the moose, the caribou, the mountain goat, the deer, and the grizzly and Alaska brown bears; and with foxes, beavers, minks, muskrats, and lynxes present in considerable numbers, there exists a real opportunity to put into effect a wild life administration program that not only will insure a continuance of game and fur animals in present numbers, but should operate to increase the stocks of many of these and of other species, which, without better protection, must rapidly go down hill. Forward-looking Alaskans are behind the work of the Alaska Game Commission. Demands are being made for more strict law enforcement than can be given by the commission through its force of seven full-time wardens. Each of these wardens is ex-

pected to handle an area of more than 70,000 square miles, as compared with only 100 square miles covered by wardens in the better organized states."

Prominent mention is made in the report of the "continued cordial relations with scientific institutions and individual research workers; with officers of state departments of agriculture, extension services, live stock and other associations, cooperating stockmen, and farmers; and with state conservation departments, the Alaska Game Commission, sportsmen's associations, hunting clubs, and individual sportsmen and other conservationists. Through the interest of cooperators in the varied duties assigned to the Biological Survey, the influence and helpfulness of the bureau is greatly extended, far beyond the sphere of activity of the limited force of workers that can be carried on its rolls."

"LIGHT BURNING" MENACE TO CALIFORNIA FORESTS

Periodically, the forest protection policy of the United States Forest Service, which seeks (1) to prevent fires from starting, and (2) to suppress quickly those that may start, is attacked by people who hold that the deliberate and repeated burning of forest lands offers the best method of protecting these lands from the devastation of summer fires. The "light burning" advocates base their contentions on the false premises that fire prevention is in the long run an impossibility, that controlled burning does protect the merchantable stands of timber, and that this can be done at a lower cost than by fire prevention methods. But they present no facts to prove the correctness of their theory.

The Forest Service is not interested in any "whispering campaign" of generalities against its fire prevention methods, unsupported by reliable observations or established facts. Its business, in so far as the national forests are concerned, is the growing of timber and the protection of watersheds. The present fire protection policy in effect in the federal forests is not based on guesswork, hearsay or local prejudice, but is the result of more than 25 years of active field experience in the fire game both in California and throughout the entire United States. This policy is being built up and improved by modern methods and inventions, because it has been proved that in the long run fire prevention and not "light burning" is the best system for protecting and conserving our rapidly disappearing forest resources.

Let us critically examine some of the

contentions of the "light burning" advocates:

1. It is stated that in the early days of Indian fires there were no great conflagrations; that the forests were open and free from brush, and that the forests withstood repeated burning without serious injury.

The records prove all these statements to be incorrect. The forests of California that were swept by early day fires now support only $\frac{1}{3}$ to $\frac{1}{2}$ the amount of timber per acre as compared to the stands growing on land which escaped fire. In other words, periodic burning has reduced our forest capital more than 50 per cent, and has also turned millions of acres of valuable timber-bearing land into brush wastes. On the 6,000,000 acres of forest land burned by early day fires, the loss from fire, insects and other results of burning is conservatively estimated at \$3,000,000,000. Can California afford to repeat such a waste?

Great conflagrations occurred in California during the early days. Records from both the northern and southern part of the state prove that these fires often burned from four to six months and frequently swept over more than 100,000 acres of forest and major watersheds before being extinguished by rain. No such conflagrations as these have destroyed the timber wealth of the state since fire prevention measures have been put into effect by the Forest Service. Writings of pioneer explorers and government surveyors also disprove the statement that the early day forests were open and free of brush. In fact, the records prove that brush was everywhere found, as today.

2. The "light burning" advocates further state that periodic fires improve grazing conditions, kill the "wood beetles" and make hunting easier. While those are largely selfish contentions, with little thought to the welfare of the forest, they, too, can be proved incorrect.

Periodic burning does at first increase the stand of forage plants, but extensive experiments have shown that if this practice is continued the noxious weeds and shrubs, which are more hardy than the forage plants, will soon take possession of the range and turn it into a weed and brush patch. Repeated fires eventually destroy or seriously reduce the productivity of valuable range lands, as is well illustrated by the hundreds of thousands of acres of worthless brush range along the borders of the great interior valleys.

Entomologists have proved that pine beetles and other destructive forest insects, which live in green not dead trees, are increasingly attracted to burned areas and readily attack and destroy trees

weakened by repeated fires. Experiments have shown that the volume of merchantable timber destroyed on a burned area by insect attack increases 250 per cent the first season following a fire. Also, that the "wood beetles" of which the "old-timers" talk so much, are in reality not destructive to green timber at all, but live entirely in dead and fallen trees and logs.

Brush in the forest undoubtedly makes game difficult to hunt. If game seeks the brush, that is evidence that the brush is attractive to it, just as is the forest. Destroy the brush and forest and you destroy the home and breeding place of wild life, as well as countless thousands of game birds and animals. Even with present forest protection methods the yearly toll of wild life taken by fire is enormous. What must it have been in the days when fires were looked upon with indifference or as a necessary evil?

But what actually does happen when the forest is periodically "light burned"?

First—Light fires, even if it were possible to properly control them, cause serious damage to the most valuable veterans of the stand by burning them at the base and causing cat-faces—a loss that amounts to several dollars per acre in merchantable timber every time a fire runs through the forest. In addition, all the little trees and saplings, which are the basis of the next timber crop, are killed outright. No more effective method of sure and total forest destruction could be devised. "Light burning" causes the same sort of forest destruction it is claimed to prevent.

Second—Another serious result of the repeated burning of forests is that the gradual destruction of the tree cover and the burning of the humus and top soil leads to the invasion of the land by worthless brush which makes the reestablishment of the forest more difficult. Furthermore, the brush is never entirely consumed by these fires, and each light burn makes more fuel for a later and more destructive fire. Over 2,000,000 acres of brush fields in the timbered regions of California today bear mute witness of

the destructive effects of the repeated burnings of the forest.

Third—"Light burning," contrary to the belief of its advocates, is not an easy practice either in the spring or fall, as extensive field experiments have proved, nor can it be carried on without damage to the forest. In rough mountainous country, such as makes up the greater part of our forested area, it is practically impossible to get the fires to "run" lightly over any large area, or to control them after they are once started. The cost of such work, 35 cents to \$1 per acre, is also prohibitive, even if the practice were a good one.

The absurdity of the "light burning" theory becomes apparent when we consider this proposal in the light of cold figures. Picture the job that the Forest Service would have to "light burn" each year over 12,000,000 acres of government timber and brush land in the national forests alone. At an average cost of 50 cents per acre for the job this would mean an annual outlay of \$6,000,000, or approximately *ten times the present yearly expenditures by all state, federal, and private individuals for fire suppression on all forest, brush and range lands in California.*

Do we want brush fields or forests in the mountains of California? If we want brush, let us "light burn" and deliberately destroy the great natural forest wealth of the state. But if we want a present and future supply of timber for homes and industry, water for irrigation, power and domestic use, an abundance of good fishing and hunting, and recreation grounds for all the people, we must stamp out this pernicious "light burning" sentiment which fosters and abets the spirit of incendiarism, and renew with added vigor the never-ending fight against the demon fire. And this will be a fight in which every citizen must join with federal, state and private interests to help wipe out the blot of man-caused fires which today marks the fair name of California as the worst fire state in the Union.

DIVISION ACTIVITIES

More and definite information relative to the abundance and estimated number of various species of game birds and mammals throughout the state is being gained. Requests that deputies in the field report the information desired have met with a ready response. It is believed that when all of this information has been collected that the division will be in a position to know the number of square miles of game country, and how densely populated it is with game. Emphasis has been placed upon the area of open territory in all sections of the state, how much territory is closed to hunting in each district, and how much is closed to all except owners of lands and their friends.

Despite the fact that his left eye can discern no more than light, Jay Bruce, state lion hunter, has been able to maintain his old record. Records from the Thirtieth Biennial Report show that state lion hunter Bruce has killed on an average of 15 per cent of the big cats destroyed by hunters yearly in California.

While Jay Bruce admits that the loss of his eye handicaps him in his work, it is predicted that he will be able to carry on without a rival, due to the methods which he has perfected and the number of years spent in hunting and shooting mountain lions.

Bureau of Patrol

To provide for greater effectiveness in the patrol work, deputies have been transferred from districts to which, in a few cases, they have been assigned to for years. The change affects deputies in all the northern counties and as far south as Porterville and San Luis Obispo.

The following are those affected by the general order of November 26, 1928:

Captain William Lippincott, transferred from Yreka to Eureka, to be captain of the district of which Eureka is the central point; Deputy Sam Gilloon was appointed captain of patrol at Shasta City; Deputy W. J. Harp, from Willits to Arcata; Deputy R. J. Yates from Crockett to Eureka; Earl P. Barnes, from Eureka to Colfax; Theodore M. Benson, from Fortuna to Maxwell; R. C. O'Connor, from Grass Valley to Los Banos; W. C. Blewett, from Los Banos to San Luis Obispo; H. E. Black, from San Luis Obispo to Madera; George Smalley, from Madera to San Rafael; Euell Gray, from Placerville to Crescent City; W. T.

Smalley, from Porterville to Willits; McPherson Lough, from Eureka to Mayfield; A. W. Sears, from Colfax to Placerville; Ralph Newsome, from Monterey to Fall River Mills; Lee Atkinson, from San Rafael to Douglas City; H. S. Prescott, from Crescent City to Crockett; R. C. Marshall, from Douglas City to Monterey; and A. H. Millett, from Fall River Mills to Shasta City.

Captain O. P. Brownlow, formerly in charge of fish planting, has been assigned a new district comprising Tulare and Kern counties with headquarters at Visalia.

In the southern patrol department only one change has been made. Deputy Sam Lyons has been promoted to captain and has charge of Santa Barbara and Ventura counties.

In appreciation of his activities and resourcefulness as captain of the volunteer deputies, San Francisco district, Allan G. Curry, has been placed on the regular patrol working out of the San Francisco office.

Taylor London was given employment during the month of November. He served as a deputy in the Colusa duck fields.

During the month of October, 242 arrests were made, 32 of which were dismissed, making a total of 210 cases. \$8,250 was levied in fines. In one instance a violator received a sixty-day jail sentence.

Deputy Forrest J. McDermott, recently assigned to the Santa Cruz district, achieved an unique record by making eleven cases in four days. Judge Donald Younger imposed fines totaling \$760.

Among the more outstanding cases were:

An arrest made by C. E. Holladay, of Morgan Hill, for the possession of 25 ducks during the closed season. Judge J. M. Moore assessed a fine of \$500.

A fine of \$250 was assessed by Judge Louis J. Morris, as the result of an arrest made by Deputy Sam Lyons. The arrest was made for the killing of a fawn.

Judge D. W. Rohrbach levied a fine of \$200 upon a violator who was apprehended by Deputy Fred Post for killing two quail during the closed season.

As the result of an arrest made by Deputy J. P. Vissiere and volunteer deputy Jacobsen, Judge Donald Younger fined

a violator \$200 for the possession of undersized Pismo clams.

One violator had in his possession untagged salmon when arrested by Captain L. T. Ward and Deputy Charles Sibeck, who brought him before Judge Silas Orr, of Sacramento. He was fined \$200.

Deputy M. I. Joy, recently assigned to San Mateo County, made four arrests in one day at Salada Beach. Judge Edward McAuliffe, of Redwood City, tried the cases, two of which were for having non-game birds in possession.

Deputies of the San Francisco bay and river patrol have seized thirty-two illegal nets during the year. Their district comprises the ocean waters near San Francisco, the north bays and rivers and sloughs, as far north as Cache Slough above Rio Vista. This area has been patrolled continuously by deputies Charles England and Charles Bouton on the *Quinnat* and William Armstrong on the *Hunter*.

It was reported that the opening of the sagehen season on August 1, in District 4½ found several hundred hunters in Long Valley and the adjacent country to Bodie in eastern Mono County. Deputies Edward Ricketts and A. H. Crocker assert that 34 limits were taken in the Long Valley section. Accurate figures are not available, but there is reliable information on hand that indicates that fewer sagehens were killed during the two weeks open season this year than during the same period last year. Conservative estimates are that about four hundred sagehens were killed in this district this season.

Bureau of Fish Culture

The Mount Shasta Hatchery has been completely overhauled, the troughs and ponds cleaned, and the screens repaired.

During the month of October, 1,510,000 trout released by this hatchery were distributed. This left 450,500 trout and 805,000 salmon for distribution during November.

A new experimental hatchery has been completed and is in operation on the Yuba River, Sierra County.

The Kings River Experimental Hatchery has proved successful. A new dam has been built, since this hatchery will now be maintained throughout the year.

A shipment of 2,000,000 eastern brook trout eggs has been received from the American Fish Culture Company, Rhode Island. They have been distributed to the various hatcheries.

Experiments are being conducted at the Brookdale Hatchery to determine losses in trout fry. The experiments are under the supervision of J. O. Snyder and George A. Coleman.

John Marshall has been transferred from the Mount Shasta Hatchery and has been placed in charge at Brookdale.

During the winter, the hatchery crews employ their time in cleaning and repainting the troughs, building dams in preparation for the winter storms, and eyeing the eggs from the egg-collecting stations.

Bureau of Commercial Fisheries

Sardine canning operations are now in full swing, necessitating the employing of several extra men to assist the regular force in checking the canneries. During September, approximately 25,000 tons of sardines were landed at Monterey as against 23,000 tons in September of the preceding year.

In the effort to conserve California sardines for food purposes, it was necessary to file suits against four canneries. These canning companies failed to pack the required number of cases from each ton of sardines brought in.

Through study made by the workers of the Bureau it has been learned that the common hoop nets, also known as crab nets, can not be used successfully in Monterey Bay.

In the past the fishermen have been in the habit of using strings in gill nets, which really make trammel nets out of them. There has been some complaint that the use of these nets were destroying female and undersized crabs. In order to avoid this destruction, it has been agreed with the crab fishermen working out of Santa Cruz and Monterey that they should use only gill nets without any strings, and of mesh not less than nine inches in length. All crabs are to be removed from these nets on the fishing grounds, and any undersized or female crabs must be returned to the water alive and uninjured.

Joe A. Craig, statistical expert of the California State Fisheries Laboratory, Terminal Island, left for the east, where he was called by the U. S. Bureau of Fisheries to remain for a month's period to do some special work on Alaskan salmon trap statistics. While in Washington that he consulted with Mr. Henry O'Malley, the U. S. Commissioner of Fisheries, and from there he went to Harvard University, where he met Mr. O. E. Settee, formerly an employee of the California State Fisheries Laboratory, and now the assistant in charge of the Division of Fisheries Industries of the U. S. Bureau of Fisheries.

Bureau of Hydraulics

Arrangements were made for the rebuilding of a fish ladder by the Clover Valley Lumber Company on Grizzly Creek, in Nevada County. The fish ladder previously installed had been washed out by the storms of last winter.

The Pacific Gas and Electric Company has repaired the fish ladder at the Folsom Dam which was damaged by the high waters of last winter. One boulder, the estimated weight of which was about 15 tons, was lodged in one pool of this fish ladder.

The Union Oil Company, cooperating with the Bureau of Hydraulics, has installed facilities to obviate pollution in the Orcutt section. Other southern California oil companies have also taken steps to avoid pollution and from investigations made, it appears that most of the oil now found on the beaches north and south of San Pedro comes from vessels entering or departing from the harbor of San Pedro.

Several inspections have been made of various dams and fish ladders, the main ones being the dams of the Feather River Power Company in Plumas County, Lassen County, and an inspection and survey of screens and ladders in the vicinity of Orleans, Siskiyou County.

Cooperating with the Bureau of Hydraulics, the Water Waste Disposal Company, of Orange County, has just finished a project for handling of oil waste at the cost of almost \$500,000. This system, which is the third of those installed in the southern California oil fields for this purpose, consists of pipe lines and tanks where the water and oil is separated. The cost of maintenance will be at least

\$50,000 annually. Pipe lines are connected with all wells and the accumulation is a heavy mixture of oil, mud and water. If allowed to flow into the natural drainage channels it becomes a serious menace to fish and plant life as well as cause of annoyance to those who seek recreation on the beaches.

The first of these systems was that of the Oil Operators Inc., which is located in the Signal Hill field near Long Beach. This system has been enlarged until ten huge settling tanks have been put in use.

Bureau of Education and Research

Dr. H. C. Bryant represented the Western Association of Game Commissioners at the Fifteenth National Game Conference held in New York City in December. Leaders in conservation from all parts of the nation attended this convention, viewpoints were exchanged, and ways and means considered for further legislation and means of protection. Dr. Bryant addressed the convention on "Conservation Fundamentals in the West" on December 3, 1928.

Official photographer E. S. Cheney has greatly augmented the prong-horned antelope film with the addition of a number of splendid close-up views of these interesting game mammals. A graphic picture of a young antelope in its natural habitat was secured, together with several views of a band in the wild. With these additions, the division is now able to give a faithful presentation of another of California's disappearing game mammals.

Additional material, sufficient to complete a reel on shorebirds, has also been secured. Outstanding in interest is a picture of a phalarope spinning and churning the water so that insects desired for food rise to the surface. A close-up of a little brown crane is considered quite remarkable when regard is had for the difficulties of stalking such a bird.

The Forest Tragedy exhibit was erected at the Lassen County Fair. Its plea for observance of the game laws lest similar tragedies be enacted made quite an impression in a country where game is so common that its abundance is considered one of the fixed facts of nature.

The miniature Mount Shasta Hatchery exhibit was displayed in the Third Annual Food Products Exposition in the

Civic Auditorium, San Francisco, in October. The portable framework for the Forest Tragedy exhibit was utilized as a background.

Bureau of Game Farms

Pheasants reared at the State Game Farm and released in Chino Valley are reported to be increasing rapidly. They have received every possible protection from the farmer in this district. Half grown pheasants in groups of from eight to sixteen birds have been seen along the roadside. Reports have come in that many birds are having a second setting.

The electric brooders recently installed at the game farm are proving very suc-

cessful with the bantams. They are being kept under close watch in order to check any possible defect.

Golden pheasants have been furnished to Griffith Park at Los Angeles and Hancock Park at Santa Maria, Santa Barbara County. These birds are supplied to parks, upon receipt of application for them, for display purposes.

Another plant of wild turkeys has been made in the mountain region where the counties of Napa, Lake and Sonoma corner. Most of the remaining stock will be sent out to individuals for breeding purposes. It is the intention to foster this plan, in order that more turkeys will be reared and wider distribution will be possible.



FIG. 26. Exhibit displaying miniature of the Mt. Shasta Hatchery. Third Annual California Food Products Show, Civic Auditorium, San Francisco, California. October, 1928.

COMMERCIAL FISHERY NOTES

N. B. SCOFIELD, Editor.

THE NORTHERN RANGE OF THE ALBACORE

The albacore, or long-finned tuna, ordinarily ranges from a short distance south of the international boundary line between California and Mexico to a short distance above the Santa Barbara Islands. Occasionally they have been taken far to the north of this. In *CALIFORNIA FISH AND GAME*, Vol. 13, No. 2, for April, 1927, C. B. Andrews, a member of the Fisheries Laboratory staff, tells, under date of December 16, 1926, of large numbers of albacore being caught near Monterey in that and the year preceding. He says, in part:

"For the second consecutive year albacore have been caught near Monterey in abundance sufficient to warrant interest. Last year (1926) was the first time in many years that albacore had been noticed and a great deal of excitement among the fishermen of San Francisco and Monterey resulted over the prospects of the development of a new industry. Albacore appeared off Point Sur and nearby regions last year about September 5, according to the notes of W. A. Selle, and were caught throughout the month and for some time following. This year they appeared in the same region late in October, and have continued to be caught intermittently throughout November and the first few days of December. * * * The gear that is being used is the ordinary market fisherman's boat equipped with jig poles and jigs which most of the fishermen carry with them. Individual boat catches range from a few pounds to well above 700 pounds and a goodly number range about 500 pounds when fishing is good."

Reviewing the statistical reports of the fish catch for the past four years as compiled by the Bureau of Commercial Fisheries, we find that in 1924, 420 pounds of albacore was brought in to Monterey while none was delivered at San Francisco. In 1925, Monterey and Santa Cruz received 439,504 pounds, while San Francisco received 20,525 pounds. In 1926, Monterey and Santa Cruz got 118,683 pounds, while San Francisco got none. In 1927, Monterey got 1051 pounds, while Santa Cruz and San Francisco did not get any albacore. It would appear from this that the albacore by 1927 had ceased to come so far north, but such a surmise may be but a good example of mistakes which are made by drawing conclusions from insufficient

evidence. The albacore may have been farther offshore or may have gone on past without the Monterey or San Francisco fishermen locating them, or both of these things may have happened. As evidence along this line we have the following from Mr. Perry Clark, of the San Francisco laboratory staff of the U. S. Bureau of Chemistry, who knows his fish so well he tells what species they are after they are in the can, no matter what the label on the can says they are. Mr. Clark has recently returned from an inspection tour in Alaska and gives us the following information regarding the occurrence of albacore well to the north of here.

About August 7, 1927, Capt. Matt Brandes, operating a schooner for the Union Codfish Company of San Francisco, took five albacore in approximately latitude 47° north and longitude 152° west. He continued to troll and caught about two albacore every other day until 22 were taken. The last ones taken were in 30° north and 125° west. The period of time covered was about August 7th to 18th. Capt. Brandes said that on his schooner they had taken albacore in previous years by using a troll and by sailing approximately on the great circle course between Unimak Pass and San Francisco. The captain was quite sure of the fish and described its long pectoral fins. The position given for the first albacore caught on about August 7th, is about one thousand miles west of Cape Flattery.—N. B. SCOFIELD.

WHALING INDUSTRY PROSPEROUS

According to the *Catalina Islander* more than 6000 barrels of whale oil, valued in excess of \$25,000, have been taken by the California Sea Products Company off San Clemente Island this past season. Operations have extended as far south as Cedros Island off the coast of Mexico. Four boats are used by this company. Another company operating three ships, one of them equipped with reduction machinery, is operating in the same waters.

AN UNAPPRECIATED FOOD FISH

As an illustration of how the appreciation of carp differs in different states: California is spending thousands of dollars in an effort to reduce the number of carp in certain waters where they are considered a pest, while in Wisconsin the privilege of seining carp is granted to

commercial interests and the state gets twenty-five per cent of the gross receipts. The state of Wisconsin has received from this source during the past five years \$262,942.51, according to the *Fishing Gazette*. During this time 18,119,882 pounds of rough fish, mostly carp, were taken from the state waters.—N. B. SCOFIELD.

OPENING DATE FOR THE 1928-1929 SARDINE SEASON

The sardine season usually opens at Monterey some three or four months earlier than in the San Pedro region. On three different years recently one or two canneries have opened as early as May, but the majority of plants have waited until June or July, and most of the Monterey canneries have been well launched in sardine packing by the middle of July. At San Pedro some plants have opened as early as September, but in most cases October is the first month of active sardine canning.

The opening date at Monterey has not been governed entirely by the appearance of fish in the fishing area. Economic conditions have played a very important part, especially the sale price of case goods, oil and fish meal, and in some cases the general financial standing of the canning plants. On a few occasions canneries have opened and found that fish were abundant but of mixed sizes, so that they were not desirable. In most cases, however, plants have been encouraged to open on a date earlier than they considered economically profitable because some one plant opened, and in this way obtained the pick of the choice fishing crews and cannery help. This caused uneasiness among the employees of other plants, and in this way indirect pressure was responsible for opening the canning season weeks in advance.

During 1928 the cannery men of the Monterey and San Pedro regions formed an organization for mutual benefit and, among other points discussed, was the question of agreeing on an opening date for each fishing port. It was considered an economic advantage for all plants in each port to open on a fixed date so that all would be on an equal footing in arranging for sales, ordering materials, contracting with fishermen, and employing cannery help. The advantages in economy of operation and in the placing of competitors on an equal basis were so obvious that opening and closing dates for sardine packing were agreed upon for Monterey and San Pedro.

This year then for the first time in the brief history of sardine canning the be-

ginning of the season has been determined by agreement and no plants began active canning operations at Monterey before August 6, and the San Pedro plants by agreement did not open until October 6. This agreement was distinctly for mutual economic advantage and was in no sense a conservation measure. The opening dates were chosen, having in mind the purpose of allowing each fishing region an equal number of months in which to operate, and were not determined solely by the appearance or behavior of sardines in the respective fishing areas. Likewise, the agreed upon closing dates for each region were selected for economic rather than biological reasons. We do not intend to imply an adverse criticism by this statement. On the contrary, the agreement for fixing opening and closing dates was very commendable and a decided economic advantage to the industry. We wish merely to point out that the agreed upon dates were selected for the benefit of the industry and not for the purpose of conserving our sardine supply.—W. L. SCOFIELD.

PISMO CLAM CENSUS

During the last week of November, the staff of the California State Fisheries Laboratory made the 1928 census of the clams on Pismo Beach. The relative number of Pismo clams is determined by digging a standard trench, termed a cross-section, through the intertidal zone in three different localities on the beach, and keeping a detailed record of the number and age of the clams in each locality. Such a census has been made yearly since 1923 and the results published in previous issues of CALIFORNIA FISH AND GAME. From 1918 to 1922 the survey was based on one cross-section.

Each year the work becomes more discouraging, for the supply of clams is declining steadily and rapidly. The results of this year's survey indicate that the 1928 set of clams was practically a failure. Clams spawned during the summer of 1928 comprised only 5 per cent of the total number of clams found. In 1927 the year's set constituted 25 per cent of the total, and in 1926, 32 per cent. There has been no heavy set of clams, however, since 1924, and individuals of this year-class are now very scarce on the beaches. Apparently, clams from this last successful spawning season will be seriously reduced in numbers if not entirely wiped out before they reach a legal size. Clams older than the 1924 year-class formed less than 1 per cent of the 1928 census. Previous to 1924 a very successful spawning occurred in 1919.

But clams of this year-class have not been taken in the intertidal zone since 1925. Individuals are still found in the surf beyond low tide line, but these clams are only available to the experienced digger.

The constant falling off in the supply of Pismo clams demonstrates that the present protective measures are inadequate to conserve this natural resource,

even for the immediate future. The closing of certain areas of beach to all digging has been suggested as the next step in the solution of this problem, and it is highly important that such a measure be enacted at the present legislative session.—FRANCES N. CLARK, California State Fisheries Laboratory, Terminal Island, California, December, 1928.

LIFE HISTORY NOTES

A CLOSE ENCOUNTER WITH A MOUNTAIN SHEEP

During a recent patrol trip to the mountains west of the Old Borego Valley in San Diego County, assisted by Special Deputy Alfred Wilson of Santa Ysabel, I had a novel experience, one which may never occur again.

We had just finished eating lunch in the shade of a desert juniper when Wilson motioned for me to look. I saw a mountain sheep feeding about 200 yards away. He was nibbling a bunch of grass on a small plateau on the side of a rocky mountain. We watched him through glasses for some little time, until he disappeared back of a large boulder. We knew he had bedded down and decided to see just how close we could get to him before he would either see or scent us.

There was a stiff west wind blowing, so we crept up-wind, making no noise and keeping the boulder, which hid him from view, between him and us. After considerable stalking we crawled upon the same boulder that shielded the sheep.

At sight of us he jumped up, stood stiff legged, with legs apart. We did not move. He watched us, not for five seconds, but for a full thirty seconds. He then made a few jumps and again turned around and watched us for a few more seconds, and instead of taking fright and running, he turned and walked away leisurely over the rocks.

After he had gone, I measured the distance. One may believe this or not, but we were within just twenty-one feet of this mountain sheep. He was an old ram, apparently in good condition. Both horns were broken and worn off at the turn. Wilson and I estimated him to weigh close to 200 pounds.

At different times while on patrol of this same vicinity, I have cut the track of mountain sheep, but this is the first time in my life that I had the pleasure to meet one in the wild.—E. H. GLIDDEN, San Diego, California.

LAMPREYS INJURE STRIPED BASS

For a number of years, striped bass fishermen have discussed the sore spots to

be found on striped bass caught in the San Francisco Bay region. Several fish recently sent in for investigation indicated that injury was due to the lamprey eel. The lamprey eels holds onto the bass by a suction of its round mouth. The normal place for fastening is on the sides or belly where the scales are not so thick. The rasp-like teeth help in cutting through the skin to secure the blood and juices of the fish.—N. B. SCOFIELD, Russ Bldg., San Francisco.

MOUNTAIN LION SEEN KILLING A DOE

The following is the account of watching a California mountain lion kill a doe.

May 1, 1928, I took my station in the Ash Mountain lookout tower in Sequoia National Park. This tower was recently constructed and is one of the most modern of fire lookouts. As wild life is protected here in the park, it became evident to me that there was much to be seen from the tower, and I therefore lived there.

Bears were my first visitors. They came for the bacon and honey that was placed out for them. Deer came later and it was very interesting to watch the young fawns take their first taste of salt, which they did surprisingly early in life.

About May 15th, a female mountain lion walked out on a ledge some two hundred yards away. This ledge is on the face of a cliff about 1200 feet high and overlooks the Kaweah River. Immediately behind the lioness were two very small, wobbly, clumsy cubs or kittens. The lioness stretched out full length in the sun and the cubs nuzzled around her. They all disappeared back in the brush about 4 o'clock in the afternoon. This was repeated for two or three weeks. The cubs grew very fast and were the most playful little animals I had ever seen.

The female lion started training the cubs on grasshoppers, for she would pounce upon them and then watch the kittens try their luck. Much time was spent in manicuring their claws on tree trunks. One small sapling is so badly scratched that I doubt if it will live.

The lioness very rarely corrected the cubs, but when she did, she was quite severe. Butterflies, also, attracted considerable of the cubs' attention.

One morning early in July, just as the sun was coming up, I was watching an old doe and a fawn on a rock-covered hillside. The doe was feeding, and being curious to know what there was to eat in such a barren place, I trained the glasses on her. There were small bunches of grass growing out of the crevices in the rock on which she was nibbling. The doe was standing with her front feet down hill. She was just raising her head when

The lion grasped the neck of the deer and pulling with her shoulder and back, half-carried the carcass about ten or fifteen feet to a comparatively level place where she laid the deer down. She then took a very careful look around.

The fawn disappeared at the first sign of trouble and I have never seen it since that I know of.

The lion then walked back, and, placing her left foot on the flank of the deer ripped the stomach open with the right. She then tore away the left flank of the deer, eating some of it and the short ribs. She cleaned the small intestines by pull-



FIG. 27. Mountain lion killed in Calaveras County by Deputy Frank Pickering, December, 1928. Photograph by Jack O'Connell.

the lioness jumped on her. I did not see the lioness until she was in midair although she was full in the finder of the glass. I am sure the doe never, at any time, knew what hit her. The lioness was spread out and landed full length on the deer, the left forefoot striking back of the deer's left shoulder and catching into the chest or lower ribs. The lion's right foot hit the deer in the neck and knocked the deer's head clear round toward the shoulder. The impact could be heard plainly from quite a distance. The deer either sank or was forced down at once. There was no struggle.

ing them from under her foot and ate a considerable amount of them. She ate well into the loin before she seemed satisfied. All during this time she would stop and look around at very short intervals.

Apparently at some given signal, the two cubs now came down out of the nearby brush. The lioness stood guard while the youngsters ate from the hams and the insides. After one cub had eaten all he wanted, the female walked between the kill and the cubs. One little fellow seemed to be still hungry, but was refused the privilege. He apparently contested her authority and was promptly

slapped, rolling over and over from the cuff.

The two cubs then came under the tower and went on to their den. The lioness retired up the hill some seventy or eighty yards to a rocky, brushy point and stretched out full length with her head between her forepaws. At 4:30 p.m. she arose and went back to the kill and ate all she could hold, in fact, when she passed below me her sides were actually bulging out. The lioness never came back to this deer, although I waited until the fourth day before going over to the kill.

During the summer, I have gone to or found eleven kills. One of them showed signs of a hard struggle; the others were mostly clean kills. The cubs must be good sized lions at the present writing, October 3, 1928, and it seems they have gone into new country as I have not seen them for over three weeks.

After this observation, I am wondering if mountain lions are not right handed as all the major activities were performed with the right foot. I had been given the impression that lions used their hind feet in killing. However, I do not wish to have it said that I doubt this statement. I was not in a position to see just

what was done with the hind feet. My entire attention was attracted to the front feet and head. It all happened so fast that probably only a slow motion camera could satisfactorily record the action.—J. GILBERT WADE, Giant Forest, California.

BLACK BRANT AGAIN ON MISSION BAY

For several years I have been watching the goings and comings of waterfowl in Mission Bay, in San Diego County, knowing that black brant appeared there. However, more recently a group has utilized the bay as a feeding ground. The present season, a flock of 17 arrived on November 16. The records for previous years have shown that these birds arrive regularly between November 15 and 20. Last season I recorded the fact that some 200 were present for a period of several months.

From all reports, the different lakes of San Diego County have had an unusually good supply of pintail, canvasback and baldpate ducks, as compared with other seasons. Scaup ducks appear to be less abundant than in former years.—AD B. PEARSON, North San Diego, California.

CONSERVATION IN OTHER STATES

GAME CONDITIONS IN ATLANTIC STATES

That there is more game today in a number of the older settled states of the Union than half a century ago is a claim made by John B. Burnham in *The American Field*, for October 13, 1928. This fact that game is being brought back he takes as evidence "of the good results of game administration under the modern system, the keystone of which is the inviolate sanctuary where nothing can be killed at any time of the year, with the exception of destructive birds and animals."

In the formerly "shot out" industrial state of Pennsylvania he points out that "game has increased to such an extent that it is worth at market value more than all of the state's domesticated stock, including sheep, cattle, hogs, horses and poultry. In the old state of Vermont, deer were exterminated shortly after the Civil War. Some Rutland County sportsmen secured seventeen deer for restocking the state. This restocking was so well administered that there are, probably, more deer to the square mile in the Green Mountain area than in almost any other place. * * *

"The most important reason why we can never have as much game as existed in colonial times has nothing whatever to do with hunting. Agriculture and industry have taken the best game ground. Industry follows the harbors and streams and the course of agriculture. Agriculture naturally takes the most fertile ground and the ground which will raise the most food for human beings will similarly raise the most food for the game; consequently agriculture and industry have driven game to the poorer lands. As long as rail fences were in existence the situation was not clearly so bad for the game, but with wire fences and close cultivation, their hiding places and refuges were destroyed. The mowing machine and the cultivator and other farming implements have destroyed the nests of ground-nesting game birds, so that there are few natural sanctuaries left. This is the reason why, through federal and state action, we must create large numbers of what, for want of a better term, may be called 'artificial sanctuaries.' Many such areas require reforestation. All of them require improvement in the food supply."

WISCONSIN GIVEN POWER TO CLOSE SEASON

Prior to the present year, no authority existed under the statutes of Wisconsin to exercise any discretion on the part of administrative authorities in the protection of fish and game. The last legislature, however, provided that the Conservation Commission shall have power to close seasons, "when it shall find after investigation and public hearing that such action is reasonably necessary for the perpetuation of any species of fish and game and the maintenance of a reasonable supply thereof." This new provision has resulted in numerous applications to the commission for additional protection to various species in some parts of the state and a series of hearings are being held to determine what action shall be taken. Additional protection has been asked for all species of grouse for a closed season on rabbits during October in certain counties.—*American Game*, August and September, 1928.

MISSOURI URGES SPORTSMEN TO ASSIST IN VERMIN CONTROL

The plan of organized control of predatory animals adopted by New Jersey sportsmen is urged by Missouri. Its commission is earnestly striving to inform sportsmen of the harm stray cats do. Acknowledged to be the most insidious destroyer of small game like rabbits, quail and squirrels, Missouri authorities urge sportsmen to wage constant warfare against the stealthy and deceptive woods cat. The goshawk and Cooper's hawk are also blacklisted and are held up for eradication by hunters.

NEW YORK SUCCEEDS IN CON- SERVING DEER

The Conservation Department of New York reports that the kill of antlered deer for 1927 was 7000. This figure is indeed impressive when it is realized that not so many years ago deer were nearly extinct in New York due to their slaughter by market hunters. By application of the buck law and adequate sanctuaries, New York has been able to restore her deer supply.

CANADIAN PARK RECEIVES BUFFALO

According to a bulletin of the American Game Protective Association, the Canadian government plans a further movement of over 1000 yearling and two-year-old buffalo from the Buffalo National Park at Wainwright, Alberta, to Wood Buffalo Park, near Fort Smith, Northwest Territories.

This shipment will bring the number of buffalo introduced in the Buffalo National Park to over 6600. Buffalo were first placed in the park in 1925, and wardens estimate that the grand total, after this year's shipment is completed, will be over 9000 head.

NATURE GUARDS ORGANIZING IN SOUTH STATES

Two of the southern states have inaugurated a very important educational movement among boys and girls. It was started by Commissioner Peter S. Twitty, of the Georgia Game and Fish Department, and has recently been inaugurated in Louisiana. The movement has taken the form of an organization of boys and girls as "Nature Guardians," the members of which are pledged to protect and preserve the wild life, including animals, birds and plants.

"The lack of information about the common things about us is almost beyond belief," says a bulletin of the American Game Protective Association, and an organization such as this will do more than anything else, not only to inform the young generation but to create an interest and love for the wild creatures and desire to protect and care for them. Very few people, comparatively, are able to identify common birds and plants which is not as it should be and accounts in a measure for the prevalent lack of interest in their preservation.

Members of the "Nature Guardians" subscribe to the following pledge:

"Upon my honor as a Nature Guardian, I promise to help take care of all our natural friends, to guard and protect them to the best of my ability, and, as far as possible, influence others to do the same.

1. I will not injure or kill a bird, fish or animal in violation of the law.
2. I will try to preserve the forests and wild flowers from destruction by fire or otherwise.
3. I will assist whenever possible the conservation agents in caring for these, my friends.
4. I will familiarize myself with the game laws of my State so as to learn how best to protect and guard the GREAT OUTDOORS.

All this I promise upon my WORD OF HONOR."

The organization is extended through schools, clubs, scout organizations, etc., and the educational departments of the two states cooperate heartily in extending its activities.

The movement is of such an excellent character that it will probably extend throughout the entire country.

(The above is a copy of an article which appeared in the *Game and Fish Conservationist* (Sept.-Oct., 1928, page

72), issued by the State Commission of Game and Inland Fisheries, Richmond, Virginia.)

ANOTHER GAME REFUGE FOR MISSOURI

The tenth auxiliary game refuge for northern Missouri was established in October. The refuge embraces 1700 acres of rolling land with an abundance of cover and water and will be stocked shortly with Chinese ring-necked pheasants.

Only three north Missouri districts remain now without auxiliary refuges.

MICHIGAN STUDIES BLACK DUCK MIGRATIONS

The black duck has displaced the mallard in Michigan and become the most important duck of interest to sportsmen. For this reason, the Conservation Commission has trapped and banded a large number of the species this season. Conservation officials are interested in knowing if these birds, which breed in the state, return after migrating to other regions.

NEW YORK REPORTS ON HUNGARIAN PARTRIDGES

Announcement is made by the Conservation Department of New York that favorable reports have been received from various parts of the state on the result of planting Hungarian partridges. In the northeastern corner of the state the Hungarians have been especially successful and have spread over considerable area and even north into Canada. A number of young broods have been seen in various sections. The final test will come after several years and after the birds have passed through the severe winter weather. The reports so far are encouraging.—*American Game*, August and September, 1928.

MONTANA HAS FIRST OPEN SEASON ON PHEASANTS

In answer to the appeals of sportsmen, farmers and landowners, the Montana Fish and Game Commission permitted a two-day open season on Chinese ring-necked pheasants, November 24 and 25, 1928. This is the first open season on the "multi-colored strutters" since their introduction several years ago.

ARKANSAS BIENNIAL REPORT HIGHLIGHTS

Some outstanding accomplishments listed by the Arkansas Commission are as follows: More than 8,000,000 fish re-

claimed and planted in live waters; 8,392,000 buffalo fry hatched and planted; 135,000 bass, bream and trout produced or procured from the United States Bureau of Fisheries and distributed; construction of world's largest fish hatchery started; 44 deer, 13 turkeys and 4443 pheasants bought or produced and liberated in suitable areas; 2000 pheasant eggs distributed among interested persons; 660 predatory animals killed; 1447 convictions gotten for game and fish law violations; 331 pieces of illegal tackle destroyed; 1669 pounds of fish and 362 pelts of fur-bearing animals, illegally taken or possessed, confiscated and donated to charity; 291 birds and animals, illegally taken or held, liberated; extensive educational work done, and more effective law enforcement provided.

OREGON RESCUES MILLIONS OF FISH

Through the efforts of the Oregon Game Commission, some four millions of bass, crappies and catfish have been rescued from waters being drained in reclamation areas about the city of Portland. It is claimed that this is a unique record. Some of the salvaged fish were placed in barren lakes and sloughs throughout the state. The waters of the Columbia and Gilbert rivers, Big Sturgeon, Marquam, Oswego, Carlton and Smith lakes and the Bybee, Columbia and Willamette sloughs all benefited greatly from this work.

NEVADA SPORTSMEN AID STATE

According to *American Game*, October and November, 1928, several Nevada counties have taken action to limit hunting to three days a week during this season. Formerly there was a provision on the statute books of the state limiting shooting in this manner. Sportsmen of the state quite generally believe that the limitation is necessary and have taken steps independently of the state law to continue it.

WISCONSIN STUDIES AGE OF FISH

A geological and natural history survey of the lakes and streams of Wisconsin will include the collection of scales of some 50,000 fish. The age of a fish can be determined by microscopic study of its scales, each year's growth being indicated by rings. By studying the scales of sample fish, it is expected that their rate of growth will be shown for various waters, and this together with other evidence collected, will furnish the Wisconsin Commission with valuable data.

REPORTS

GAME CASES

July, August, September, 1928

Violation	Number arrests	Fines imposed	Jail sentences imposed (days)
Hunting License Act.....	95	\$2,445	340
Deer: closed season; does, fawns, deer tag license act.....	132	9,875	250
Deer: running with dogs, closed season.....	3	100	-----
Ducks: closed season, over limit.....	22	1,115	30
Geese: closed season.....	1	25	-----
Doves: closed season, over limit.....	26	1,000	180
Quail: closed season, over limit.....	35	1,435	-----
Pheasants: closed season.....	3	125	-----
Sagehens: closed season.....	1	25	-----
Grouse: closed season.....	2	35	-----
Pigeons: over limit, closed season.....	2	50	-----
Shore birds.....	2	75	-----
Non-game birds.....	9	575	-----
Rabbits: cottontail and brush, closed season.....	14	435	-----
Squirrels, tree: closed season.....	1	25	-----
Sierra hare.....	1	-----	-----
Night hunting.....	5	50	-----
Game refuge: hunting or possession of firearms in.....	13	500	-----
Shooting from automobile.....	10	160	25
Bird traps.....	1	-----	100
Commercial Gun Club License Act.....	1	25	-----
Trespass.....	1	25	-----
Totals.....	380	\$18,100	925

FISH CASES

July, August, September, 1928

Violation	Number arrests	Fines imposed	Jail sentences imposed (days)
Angling License Act.....	72	\$1,605 00	32½
Commercial Fishing License Act.....	36	230 00	-----
Trout: over limit.....	12	322 50	-----
Black bass: undersized.....	15	355 00	20
Striped bass: over limit, undersize.....	50	1,590 00	-----
Salmon: over limit.....	2	125 00	-----
Clams: undersize and over limit.....	82	2,735 00	-----
Lobsters: under or over size.....	5	200 00	-----
Abalones: undersize, over limit.....	20	655 00	100
Halibut: over limit, undersize.....	2	50 00	-----
Barracuda: undersize.....	6	180 00	-----
Sturgeon possession of.....	2	25 00	-----
Illegal night fishing.....	1	-----	-----
Illegal fishing: within 250 feet fishway; 150 feet lower side of dam.....	2	50 00	-----
Nets, traps, seines, lines; illegal possession or use of.....	24	2,620 00	207
Failure to keep commercial fishing data.....	1	10 00	-----
Fishing in closed district.....	7	125 00	-----
Small fish.....	3	225 00	-----
Pollution.....	1	200 00	-----
Totals.....	343	\$11,302 50	359½

SEIZURES OF FISH AND GAME

July, August, September, 1928

Halibut, pounds.....	565
Sunfish, perch.....	29
Catfish.....	2
Black bass.....	101
Striped bass.....	263
Trout.....	193
Abalones, pounds.....	4,330
Salt water eels.....	12
Clams.....	1,796
Crabs.....	65
Blue fin tuna, pounds.....	2,668
Benita, pounds.....	2,862
Barracuda, pounds.....	2,529
Shad.....	6
Carp.....	5
Salmon.....	340
Sturgeon.....	2
Lobsters.....	1,479
Pigeons.....	2
Shorebirds.....	23
Sierra Hare.....	1
Ducks.....	178
Mud hens.....	2
Rabbits.....	45
Quail.....	41
Pheasants.....	1
Non-game birds.....	37
Grouse.....	2
Doves.....	380
Sagehens.....	6
Geese.....	3
Deer.....	46
Deer meat, pounds.....	353
Deer hides, green.....	3
Nets, traps.....	2

STATEMENT OF INCOME

For the Period July 1, 1928, to September 30, 1928 of the Eightieth Fiscal Year

License sales:	Detail	Total
Angling licenses—1927.....	\$1,040 00	
Angling licenses—1928.....	147,686 70	
Hunting licenses—1928.....	65,686 00	
Market fishermen's licenses—1928-29.....	19,990 00	
Wholesale fish packers' and shell fish dealers' licenses—1928-29.....	690 00	
Game breeders' licenses—1928.....	60 00	
Fish breeders' licenses—1928.....	35 00	
Trapping licenses—1928-29.....	329 00	
Commercial hunting club—1928-29.....	1,075 00	
Commercial hunting club operators—1928-29.....	335 00	
Deer tag licenses—1928.....	20,142 00	
Total license sales.....		\$257,068 70
Other income:		
Game tag sales.....	\$6 30	
Court fines.....	21,368 44	
Fish packers' tax.....	30,055 77	
Kelp tax.....	48	
Fish tag sales.....	1,790 74	
Crawfish inspection.....	21 00	
Interest on bank deposits.....	1,353 07	
Miscellaneous sales.....	113 85	
Total other income.....		54,709 65
Total income.....		\$311,778 35

CALIFORNIA FISH AND GAME

DEER KILLED IN 1927-1928, BY COUNTIES

County	Deer killed 1927	Deer killed 1928	Land area, square miles
Siskiyou.....	1,665	1,654	6,256
Mendocino.....	1,475	1,468	3,539
Lake.....	901	1,038	1,238
Tulare.....	744	939	4,856
Santa Barbara.....	669	851	2,740
Tehama.....	799	846	2,925
Monterey.....	757	830	3,330
Trinity.....	921	800	3,096
Humboldt.....	821	777	3,575
Fresno.....	592	763	5,950
Sonoma.....	751	753	1,582
Modoc.....	510	729	3,823
Shasta.....	612	603	3,858
Glenn.....	623	592	1,337
Plumas.....	551	586	2,593
Napa.....	442	569	783
El Dorado.....	535	548	1,737
Santa Clara.....	397	536	1,328
San Luis Obispo.....	394	450	3,334
Marin.....	367	444	529
Lassen.....	296	393	4,531
Los Angeles.....	425	369	4,115
Ventura.....	274	362	1,878
Placer.....	341	346	1,411
San Benito.....	217	320	1,392
Madera.....	260	300	2,112
Kern.....	218	295	8,003
Colusa.....	263	272	1,140
Alameda.....	220	263	732
Riverside.....	323	249	7,223
Inyo.....	173	239	9,991
San Diego.....	169	232	4,221
Tuolumne.....	213	213	2,190
Butte.....	228	212	1,698
Calaveras.....	149	191	1,027
Yolo.....	115	169	1,014
Nevada.....	125	140	974
Mariposa.....	95	134	1,463
San Bernardino.....	74	122	20,175
Stanislaus.....	91	115	1,450
Sierra.....	101	102	923
Santa Cruz.....	78	92	435
San Mateo.....	77	89	447
Amador.....	59	78	601
Orange.....	56	69	795
Merced.....	67	68	1,995
Alpine.....	67	66	776
Mono.....	36	55	3,030
Solano.....	45	52	822
Yuba.....	53	52	632
Del Norte.....	42	48	1,024
San Joaquin.....	21	14	1,448
Contra Costa.....	5	6	714
Imperial.....	1	4	4,089
Kings.....	3	3	1,159
Sutter.....	1	3	608
Sacramento.....		2	983
San Francisco.....			42
Totals.....	19,507	21,515	155,672

HUNTERS KILLING TWO DEER

County of residence	Number of hunters	County of residence	Number of hunters
Alameda.....	90	Riverside.....	29
Alpine.....	1	Sacramento.....	39
Amador.....	8	San Benito.....	35
Butte.....	42	San Bernardino.....	20
Calaveras.....	11	San Diego.....	30
Colusa.....	40	San Francisco.....	108
Contra Costa.....	26	San Joaquin.....	29
Del Norte.....	6	San Luis Obispo.....	68
El Dorado.....	24	San Mateo.....	23
Fresno.....	93	Santa Barbara.....	98
Glenn.....	49	Santa Clara.....	66
Humboldt.....	80	Santa Cruz.....	23
Imperial.....	2	Shasta.....	63
Inyo.....	28	Sierra.....	5
Kern.....	64	Siskiyou.....	120
Kings.....	13	Solano.....	29
Lake.....	49	Sonoma.....	102
Lassen.....	9	Stanislaus.....	19
Los Angeles.....	202	Sutter.....	20
Madera.....	14	Tehama.....	34
Marin.....	45	Trinity.....	31
Mariposa.....	6	Tulare.....	77
Mendocino.....	105	Tuolumne.....	10
Merced.....	7	Ventura.....	34
Modoc.....	7	Yolo.....	39
Mono.....	1	Yuba.....	9
Monterey.....	82	Iowa, State of.....	1
Napa.....	33	Oregon, State of.....	2
Nevada.....	4	Nevada, State of.....	1
Orange.....	37	Nebraska, State of.....	1
Placer.....	19		
Plumas.....	17	Total.....	2,379

[illegible]

[illegible]

CALIFORNIA FISH AND GAME

STATISTICS ON DEER KILL, SEASON 1928—Continued

County where deer was killed	County of residence of hunter																			
	San Mateo	Santa Barbara	Santa Clara	Santa Cruz	Shasta	Sierra	Siskiyou	Solano	Sonoma	Stanislaus	Sutter	Tehama	Trinity	Tulare	Tuolumne	Ventura	Yolo	Yuba	Non-residents	Totals
Alameda	9		14				1			1				1		1				263
Alpine	1		1					1		2										66
Amador	2						1	2									2	5		78
Butte			3	2						12	5				6					212
Calaveras	3		2					1		1	21						28	4	2	191
Colusa																				191
Contra Costa																				272
Del Norte	1			2					1	1						2	1	2		6
El Dorado	2	1	2	1				10	2	4	1					5				48
Fresno	2	4	8	3				15	10	2				84			44	8	1	548
Gleim	2		9	6	5		2	1	30	1	34	14					2			763
Humboldt	7				2					14			6				2			592
Imperial																				777
Inyo																4				4
Kern														2		4				239
Kings														3		6				295
Lake	16	3	14	2			2	44	63	8	12			2				3		3
Lassen			14	8	13		1	7	9	9	9	3		2			27	2	2	1038
Los Angeles		3															1	9		393
Madera		2	1	3				4	45	5				3			1			369
Marin	4		2				1			1										300
Mariposa	1		2	2						14				1						444
Mendocino	41	1	30	4			1	18	148	5	3	5	1			1	5	3	1	134
Merced				7						1	3									1,468
Modoc	4	7	12	8	13	2	11	9	56	17	16	6		15	1	3	17	12	5	68
Mono																				729
Monterey	9	2	30	53						1						1				55
Napa	5	7						76	17	5	4			1		4				830
Nevada	1	2					1	2		3	3						1	10		569
Orange																				140
Placer			10	1			1	1	17										5	69
Plumas	1		14	3		13		10	4	5	25	10		1	1	2	10	14	3	346
Riverside																				586
Sacramento																				249
San Benito	5		13	14						1				4			1			2

San Bernardino	266	651	699	235	479	53	1,020	306	1,011	264	218	289	209	501	146	282	339	132	81	21,515
San Diego																				
San Francisco																				
San Jose																				
San Joaquin																				
San Luis Obispo																				
San Mateo	74	39	3	2																
Santa Barbara			5	2																
Santa Clara				1																
Santa Cruz	30	564	392	7																
Santa Cruz	3	1	7	69																
Shasta	4	2	12	5	348															
Sierra			1																	
Siskiyou	15	1	30	12	41	37	983	20	15	6	9	15	2	7						
Solano	1							37	1											
Sonoma	5	1	7					7	504	2										
Stanislaus			3	1						63										
Sutter																				
Tehama	8		28	5	7			6	21	15	38	205								
Trinity	7		19	10	50			2	3	53	31	10	15	200						
Tulare	3	11	1																	
Tubumne	2		1	1					1	18										
Ventura																				
Yolo									6	1	2									
Yuba				1				1			3									
Totals	266	651	699	235	479	53	1,020	306	1,011	264	218	289	209	501	146	282	339	132	81	21,515

DEER KILLED IN DISTRICTS 2-2½-3 AUGUST 1-SEPTEMBER 14, 1923

	Aug. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Alameda.....	42	14	10	13	15	4	1	2	4	1	3	8	2	5	4	3	2	3	15	5	1	2	3
Colusa.....	45	26	24	12	9	2	2	7	3	4	5	8	2	5	7	7	7	3	4	1	2	1	5
Contra Costa.....	1																						
Fresno.....	15	7		2	4		2		1		1	2	4	7	1	1	1	2	2	2	1	3	2
Glenn.....	131	64	43	33	32	14	5	15	7	9	11	14	1		9	14	6	14	17	8	6	3	7
Kern.....	10	4		3	5	3	1	3	2	2	1	2	1								1		
Kings.....		1			1																		
Lake.....	168	69	67	44	46	15	17	14	11	16	15	30	12	18	10	12	10	18	22	7	7	7	6
Marin.....	37	8	13	6	34	2	2	10	9	4	10	27	4	3	5	4	2	6	23	1	6	5	2
Mendocino.....	181	89	94	68	55	19	31	25	24	30	28	18	24	22	18	18	10	28	32	9	14	10	17
Merced.....	11	6		1	5	2				1		6			4	1			1	1		1	2
Monterey.....	94	44	50	29	27	13	16	9	13	10	12	16	13	11	7	18	11	9	32	7	5	9	12
Napa.....	78	34	24	15	41	3	5	6	6	6	17	28	1	4	6	7	6	10	26	4	7	2	4
San Benito.....	54	14	9	8	21		2	8	1	4	7	11	2	2	2	4	4	2	13	3	2	4	5
San Francisco.....																							
San Joaquin.....	7									1									1				
San Luis Obispo.....	54	19	11	19	20	4	10	3	3	2	5	20	7	6	5	3	2	7	13	2	3	1	4
San Mateo.....	15				5		1	2			1	7		3	2	1		6	5	1	1		
Santa Barbara.....	149	63	32	39	52	20	11	11	13	9	13	24	9	8	18	17	15	14	24	7	8	12	9
Santa Clara.....	72	22	15	15	33	4	3	7	8	6	8	23	6	3	4	5	3	3	17	4	1	3	4
Santa Cruz.....	13	9	4	1	6	1	2		1			11		1				2	4	1			
Solano.....	6	1			5	1	1		1	1	3	3							1		1		
Sonoma.....	74	20	15	22	39	10	10	7	11	9	9	31	4	8	4	11	9	18	29	6	3	9	7
Stanislaus.....	12	9	2	6	7					3	1	2			1	2	1	1	9	4	2	1	2
Ventura.....	93	29	19	18	21	5	6	7	8	5	5	17		5	3	4		3	9	4	4	3	2
Yolo.....	26	4	2	4	11	2	1			2	4	5		2	4		1	3	4	1		2	2
Totals.....	1,388	556	436	365	496	124	136	136	126	126	159	313	91	114	114	134	90	159	300	75	73	77	93

DEER KILLED IN DISTRICTS 2-2½-3 AUGUST 1-SEPTEMBER 14—Continued

	24	25	26	27	28	29	30	31	Sept. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	Totals
Alameda.....			13	2	2	4	3	2	2	7	3		1	3	3	5	13	3	5	8	11	11	263
Colusa.....	1	2	8	1	1	5	3	4	8	7	3			4	1	4	6	3	2	4	9	6	272
Contra Costa.....								1															6
Fresno.....		1	1			1	1	3	1	8											1	2	62
Glenn.....	4	4	7	7	6	3	7		1	6	7	2	5	5	6	5	8	6	3	3	5	4	592
Kern.....		2							1	1								2	1			1	49
Kings.....																							3
Lake.....	10	8	24	6	5	8	9	4	17	40	34	6	11	9	8	20	44	21	11	37	29	36	1,038
Marin.....	1	6	16	3	1	7	2	3	4	26	15	3	6	8	10	4	25	30	10	5	11	19	444
Mendocino.....	18	22	34	10	14	12	21	23	19	50	24	12	14	16	16	29	63	38	29	42	42	56	1,468
Merced.....	1	2	3	3					1		1		2			3	3			1			1,66
Monterey.....	6	15	15	4	9	11	5	8	7	19	20	9	10	9	8	16	40	26	25	36	37	28	830
Napa.....	1	11	25	2	3	4	7	2	5	24	15	3	7	6	4	11	30	11	9	7	20	24	569
San Benito.....	3	6	11	3	3	4	3	4	2	12	5	1	3	4	5	8	14	14	2	11	9	11	320
San Francisco.....																							14
San Joaquin.....	4	7	14	5	4	7	7	2	6	10	7	4	1	2	6	8	28	11	8	1	28	29	450
San Luis Obispo.....		1	1	2		1	3			4	5		3	2		1	5	5		27	2	2	89
San Mateo.....	1	1	15	13	10	8	8	3	6	9	18	4	9	5	9	1	29	14	9	13	28	24	851
Santa Barbara.....	1	5	22	3	3	5	3	2	8	28	18	4	4	6	2	8	29	15	16	30	30	27	536
Santa Clara.....	5	12	22	1			3		1	6	18		1			2	2	5	1	3	1	5	92
Santa Cruz.....			6																				52
Solano.....		1	2			2		1			1				2	2	2		2	3	5	1	
Sonoma.....	5	12	31	12	8	5	7	12	11	35	24	6	8	9	13	18	56	30	10	17	23	36	753
Stanislaus.....		2	2	1	2				1	1	4					1	6	3		3	5	10	108
Ventura.....	2	6	13	3	4		5	1	5	9	1	1	3	6	2	5	3	8	6	6	8	8	362
Yolo.....		2	5	1	2	1	2		7	2	1		2	2		5	9	8	5	11	6	17	169
Totals.....	65	125	269	77	78	91	103	80	121	322	204	55	91	94	97	164	418	249	155	253	308	358	9,458

DEER KILLED IN DISTRICT 1½ SEPTEMBER 1-OCTOBER 15, 1923

	Sept. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Del Norte.....	2	2	2	1	2	1	1	2	3	1	1	-----	1	-----	4	2	3	-----	3	1	2	1	4
Humboldt.....	75	53	28	14	15	20	9	15	34	12	20	28	21	21	14	20	7	-----	8	7	7	4	18
Siskiyou.....	206	110	71	47	34	46	40	41	67	28	26	44	16	15	24	48	22	21	22	17	24	14	28
Totals.....	283	165	101	62	51	67	50	58	104	41	47	72	38	36	42	70	32	30	33	25	33	19	50

DEER KILLED IN DISTRICT 1½ SEPTEMBER 1-OCTOBER 15, 1923—Continued

	24	25	26	27	28	29	30	Oct. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Totals
Del Norte.....			1		1	1		1	12	16	16	12	13	21	5	1	1	15	30	31	47	2	48
Humboldt.....	4	9	11	10	9	4	10	5	19	18	28	31	28	43	21	8	17	15	30	31	47	13	777
Siskiyou.....	11	32	21	22	22	13	36	17	31	34	44	41	41	64	26	32	31	34	44	48	55	43	1,664
Totals.....	15	41	33	32	32	18	46	17	31	34	44	41	41	64	26	41	49	49	74	79	104	56	2,479

DEER KILLED IN OTHER DISTRICTS SEPTEMBER 16-OCTOBER 15, 1928

	Sept. 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Alpine.....	21	6	4	3	2	3	3	1		1	2	3	4	2	5
Amador.....	17	4	2	4	3	2	2	9		1	3			1	9
Butte.....	40	16	3	3	3	2	3	5	2	3	3	4	4	5	14
Calaveras.....	35	16	8	9	3	4	5	7	3	1	2	1	4	3	25
El Dorado.....	134	28	19	11	16	8	16	30	1	6	3	8	7	9	12
Fresno.....	125	61	52	36	34	13	21	23	8	8	5	13	16	13	12
Imperial.....	45	1						1							6
Inyo.....	45	15	10	11	7	6	7	10	2	3	1	4	2	6	10
Kern.....	49	14	13	9	4	1	2	12	3		5	3	2	4	
Kings.....															
Lassen.....	56	21	25	23	11	17	7	18	10	8	8	10	5	6	15
Los Angeles.....	69	21	13	12	8	5	6	13	2			5	5	6	9
Madera.....	84	23	22	13	7	8	8	11	3		6	3	5	5	8
Mariposa.....	25	3	5	1		4	5	4	2	5	3	2	2	2	3
Merced.....															
Modoc.....	111	65	62	38	33	22	16	30	15	17	7	9	12	4	14
Mono.....	18	1	2	2	1		2	3	1	2			1		1
Nevada.....	18	5	4	5	3	3	4	9	2	3	4		2	3	9
Orange.....	7	2	1	1	2	3	6	5	2	1	1		2	1	3
Placer.....	80	29	23	16	14	13	5	18	4	3	3	2	6	9	13
Plumas.....	95	38	32	23	21	17	15	25	15	12	17	19	18	9	20
Riverside.....	24	13	13	-	4	5	8	7	1	4	6	4	4	6	7
Sacramento.....															
San Bernardino.....	21	7	4	1	1		4	4	1	1	1	1	3		5
San Diego.....	22	9	5	6	7	3	7	2	2	10	3	2	5	4	14
San Joaquin.....															
Shasta.....	77	23	32	17	18	10	14	31	12	13	7	11	6	16	21
Sierra.....	16	7	7	3	2	7	1	1	6	3		3	2	1	12
Stanislaus.....	2	1				1					1				
Sutter.....															
Tehama.....	84	53	38	39	32	21	24	10	14	10	5	23	21	14	23
Trinity.....	104	46	48	56	47	18	20	16	25	20	19	16	14	16	17
Tulare.....	230	105	62	44	43	28	32	21	16	18	12	7	15	12	14
Tuolumne.....	42	4	7	3	3	4	2	14	1	1	4	5	5	8	13
Yuba.....	9	2	1	1		2	1	4			1		1		3
Totals.....	1,661	638	518	394	329	231	246	352	147	155	132	159	160	166	305

DEER KILLED IN OTHER DISTRICTS SEPTEMBER 16-OCTOBER 15, 1923—Continued

	Oct. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Totals
Alpine.....		2	1	1		2	1	1		2		1		1		66
Anador.....		1	3				3			1		2	3	6		78
Butte.....	4	5	1	6		7	15	4		4	7	2	14	16	9	212
Calaveras.....		2	1	4	3	1	12	1		7	4	5	5	16	7	191
El Dorado.....		7	12	9	9	9	25	9	13	14	12	13	21	43	23	548
Fresno.....	8	9	8	10	8	9	16	17	7	13	15	26	34	57	24	701
Imperial.....					1	1										4
Inyo.....	3	1	4	8	2	10	11	5	3	1	3	4	18	19	12	239
Kern.....	1	2	1	1	5	5	13	4	1	4	7	10	11	31	11	246
Kings.....																
Lassen.....	12	4	14	9	10	8	15	3	5	8	11	14	11	14	15	393
Los Angeles.....	15	3	5	11	4	10	29	4	3	6	9	12	35	44	15	369
Madera.....	2	3	4	1	1	8	9	7	1	3	5	10	13	16	11	300
Mariposa.....	1	2	1	2	2	2	5	3		4	5	7	9	17	8	184
Merced.....													1	1		2
Modoc.....	10	16	16	20	17	15	27	17	19	10	15	29	16	25	22	729
Mono.....			1	1			1				3	3	2	7	3	55
Nevada.....	7	2					6	2	6			4	7	16	10	140
Orange.....		4		2	2	2	3			1	3		2	7	5	69
Placer.....	4	5	4	2	5	4	18	2	1	7	3	7	2	23	15	346
Pumas.....	4	16	20	17	14	11	26	13	9	8	11	16	14	22	22	586
Riverside.....	3	4	5	4	5	3	16	1	3	5	5	9	28	38	13	249
Sacramento.....		1														2
San Bernardino.....		1				3	7	2		2	4	1	8	29	6	122
San Diego.....	2	3	8	7		6	9	6	2	8	8	9	20	16	20	232
San Joaquin.....	11	21	16	7	25	30	21	14	16	14	15	24	33	40	8	603
Shasta.....					3	2	1	1		2	1	1	4	7	2	102
Sierra.....																7
Stanislaus.....																3
Sutter.....																
Tehama.....	10	9	20	17	32	23	35	21	25	30	30	45	38	69	31	846
Trinity.....	5	19	15	18	28	23	24	19	18	24	20	28	20	44	18	800
Tulare.....	6	15	14	6	14	17	22	12	16	23	23	33	37	41	13	939
Tuolumne.....	1	4	2	8		3	10	5	6	7	10	6	4	23	8	213
Yuba.....	2	2			3	1			1	3	3		1	5	2	52
Totals.....	118	168	179	181	202	219	390	166	161	214	231	326	418	688	324	9,578

STATEMENT OF EXPENDITURES

For the Period July 1, 1928, to September 30, 1928, of the Eightieth Fiscal Year

Function	Materials and supplies	Salaries and wages	Service and expense	Property and equipment	Total
Administration:					
Executive and legal		\$3,855 00	\$528 31	\$469 05	\$4,852 36
Clerical and office	\$219 78	4,463 38	901 02	2 75	5,586 93
Rent			1,687 26		1,687 26
Automobiles	60 45		27 74		88 19
Telephone and telegraph			1,177 33		1,177 33
Postage			1,092 08		1,092 08
Freight, cartage and express			944 32		944 32
Printing	507 60				507 60
Accident and death claims			652 18		652 18
Commissioners			96 94		96 94
Total administration	\$787 83	\$8,318 38	\$7,107 18	\$471 80	\$16,685 19
Education:					
Director and assistants	\$84 66	\$3,674 44	\$935 80	\$342 14	\$5,037 04
Pacific Southwest Exposition	1,020 01	248 75	1,329 82		2,598 58
Total education	\$1,104 67	\$3,923 19	\$2,265 62	\$342 14	\$7,635 62
Publicity:					
Director		\$825 00	\$90 64		\$915 64
State fair	\$212 21	357 00	731 21		1,300 42
Total publicity	\$212 21	\$1,182 00	\$821 85		\$2,216 06
Conservation and protection:					
Chief and assistants	\$39 55	\$2,175 00	\$527 22		\$2,741 77
Clerical and office	8 79	750 00			758 79
Rent			92 46		92 46
Automobiles	238 20		124 05	\$14 33	376 58
Captains and deputies	50 24	53,386 45	38,928 22		92,364 91
Patrol launches	325 53	525 00	248 81	139 00	1,238 34
Lion hunters		185 00			185 00
Covote trappers		358 88			358 88
Lion bounties			1,070 00		1,070 00
Fish planting	553 71	630 00	1,363 58		2,547 29
Refuge posting	143 11	1,894 18	516 21		2,553 50
Fish reclamation and rescue		505 00	458 22		963 22
Total conservation and protection	\$1,359 13	\$60,409 51	\$43,328 77	\$153 33	\$105,250 74
Commercial fisheries:					
Chief and assistants	\$14 55	\$2,235 00	\$469 07	\$436 71	\$3,155 33
Deputies	19 75	6,399 68	2,125 29		8,544 72
Patrol launches	484 36	795 00	485 32		1,764 68
Statistical	5 18	1,675 00	101 61		1,781 79
Laboratory	261 81	9,931 93	1,984 10	65 09	12,242 93
Salmon tagging			26 00		26 00
Botulism			3,750 00		3,750 00
Automobiles	104 39		64 40		168 79
Carp eradication	618 55	500 00	155 35		1,273 90
Total commercial fisheries	\$1,508 59	\$21,536 61	\$9,161 14	\$501 80	\$32,708 14
Fish culture:					
Chief and assistants	\$7 18	\$1,050 00	\$75 50		\$1,132 68
Clerical and office	25 33	1,080 67	126 62	\$85 05	1,317 67
Rent			49 00		49 00
Automobile	1,252 52		594 65	52 55	1,899 72
Hatcheries	19,730 89	36,366 65	5,183 46	392 34	61,673 34
Hatcheries—additions and betterments				465 22	465 22
Special field investigation	1 50	2,265 00	1,227 12	7 18	3,500 80
Total fish culture	\$21,017 42	\$40,762 32	\$7,256 35	\$1,002 34	\$70,038 43
Hydraulics:					
Chief and assistants	\$101 73	\$1,410 00	\$402 25	\$38 50	\$1,952 48
Cooperative research work		750 00	123 98		873 98
Total hydraulics	\$101 73	\$2,160 00	\$526 23	\$38 50	\$2,826 46
Game propagation:					
Game farm—Yountville	\$2,400 84	\$2,398 44	\$681 24	\$90 75	\$5,571 27
Automobiles	32 55		55 71		88 26
Total game propagation	\$2,433 39	\$2,398 44	\$736 95	\$90 75	\$5,659 53
Research:					
Chief and assistants	\$10 31	\$3,240 00	\$451 98	\$70 00	\$3,772 29
License commissions			\$11,624 35		\$11,624 35
Total division of fish and game	\$28,535 28	\$143,930 45	\$83,280 42	\$2,670 66	\$258,416 81

CALIFORNIA FISH AND GAME

CALIFORNIA FRESH FISHERY PRODUCTS FOR THE MONTHS OF JULY, AUGUST AND SEPTEMBER, 1928

Compiled by Division of Fish and Game, Bureau of Commercial Fisheries

Species of fish	Del Norte, Humboldt.....	Mendocino, Sonoma, Lake ..	Marin.....	Solano, Yolo.....	Sacramento, San Joaquin.....	Alameda, Contra Costa...	San Francisco, San Mateo.....	Santa Cruz.....	Monterey.....
Albacore.....							68,820		180
Anchovies.....									12,105
Barbacuda.....								21	
Bonito.....				302	3,076	5,244		506	
Carp.....		1,959		553	49,728	34,039			
Crab.....		37,710	240		65		130,336	18,606	17,422
Cultus Cod.....	33,987	7,720					109,102	15,549	411
Flounders.....		260					42,671	9,755	29,400
Grayfish.....							32,565	11,574	
Hake.....							10,614	1,351	5,927
Halibut.....	99,974	25,912	27		50		1,000		140
Hardhead.....							17,245	10,636	3,215
Herring.....							135	732	348,519
Kingfish.....									5,035
Mackerel.....									
Mackerel—Horse.....									
Mullet.....	3,940		4,428		109	15	16,477	1,268	7,999
Perch.....									
Pike.....									
Pompano.....									
Rock Bass.....	25,565	1,017	265				240,596	340,955	254,453
Rockfish.....	63,686	360					100,608	24,254	9,998
Sablefish.....	920,816	1,018,490		103,732	128,309	211,370	568,458	26,732	32,549
Salmon.....		1,040					223,466	74,688	37,413
Sandbars.....							4,932,301	233	93,863,736
Sardines.....								763	100
Sculpin.....									
Sea Bass—Black.....			7,806				6,556	22,187	3,186
Sea Bass—White.....				6		5,242			
Shad.....					1,756	2,029			
Shad—Buck.....				6	15				
Shad—Roe.....									
Sheepshead.....		1,170					59,462	15,013	15,285
Skates.....								1,104	
Stripjack.....								68,951	19,439
Smelt.....	4,363	235	23,844				20,578		

CALIFORNIA FRESH FISHERY PRODUCTS FOR THE MONTHS OF JULY, AUGUST AND SEPTEMBER, 1923—Continued

Compiled by Division of Fish and Game, Bureau of Commercial Fisheries

Species of fish	San Luis Obispo, Santa Barbara, Ventura.....	Los Angeles.....	Orange.....	San Diego, Imperial.....	Total.....	Fish from South of the International Boundary brought into California via San Pedro....	Fish from South of the International Boundary brought into California via San Diego....	Total fish from South of the International Boundary brought into California....
Albacore.....	190	253,528	4,904	24,136	282,938			284,678
Anchovies.....	3,862	3,862	1,767		86,254			86,254
Barbacuda.....	4,978	1,251,223	17,626	347,485	1,621,333			1,621,333
Bonito.....	417	498,241	2,713	259,954	761,831			761,831
Carp.....					8,622			8,622
Catfish.....					86,279			86,279
Cutts Cod.....	210	41			238,552			238,552
Flounders.....		896	16		133,759			133,759
Grayfish.....		35,462	117		117,665			117,665
Hake.....					44,139			44,139
Halibut.....					239,097			239,097
Hardhead.....	70,309	81,764	1,148	2,071	150			95,635
Herring.....					1,140			1,140
Kingfish.....		31,078	40	2,066	64,310			64,310
Mackerel.....	3,939	11,351,004	342,622	837,869	12,914,810			12,914,810
Mackerel—Horse.....		206,351			211,386	162		162
Mullet.....		3,485	1,866	13,586	18,937			18,937
Perch.....	1,607	19,378	15	5,537	60,649			60,649
Pike.....					124			124
Pompano.....		304		228	532			532
Rock Bass.....	2,365	143,202	36,827	66,040	248,434			248,434
Rockfish.....	21,892	312,084	4,457	241,037	1,442,371			1,442,371
Sablefish.....		751			199,637			199,637
Salmon.....	5				3,010,451			3,010,451
Sardines.....	15	4,903	8		305,523			305,523
Sea Bass.....		71,977	620	8,201	98,882,083			98,882,083
Sea Bass—Black.....	609	32,764		5,727	39,354			39,354
Sea Bass—White.....	64,151	17,660	1,866	27,132	47,267	358	59,539	59,897
Shad.....		228,009	2,420	82,436	416,751	12,827	223,567	236,394
Shad—Buck.....					5,248			5,248
Shad—Roe.....					3,785			3,785
Sheepshead.....	5,200	42,937	241	5,693	21			21
Skates.....		5,204			54,071			54,071
Skippack.....		1,232,655		2,821,449	96,134			96,134
Smelt.....	14,561	85,753	20,322	3,455	4,055,203	2,100,684	2,914,766	5,015,450
					261,521		54	54

Sole.....	65,882	38,852	196		2,520,538		
Spittail.....					175		
Striped Bass.....					83,229		
Swordfish.....		46,741			289,975		
Tomcod.....					10,223		
Tuna—Bluefin.....		8,576,686	33		10,322,792		
Tuna—Yellowfin.....		68,609	49		73,843		
Turbot.....					5,466		
Whitebait.....					31,067		
Whitefish.....	70	18,805			34,376		
Yellowtail.....	71	180,818	4,313		827,263		
Miscellaneous.....	2,074	42,022	354		60,404		
Total fish.....	258,535	24,917,039	444,540		140,279,627		
Crustaceans:							
Crabs.....					9271,488		
Shrimps.....					843,382		
Mollusks:							
Abalones.....	1,236				815,536		
Clams—Cockle.....					10,746		
Clams—Mixed.....					3,175		
Clams—Pismo.....		174			44,023		
Clams—Soft-shell.....	43,986				41,685		
Cuttlefish.....					4,852		
Mussels.....							
Oysters—Eastern.....					619,755		
Oysters—Native.....					11,500		
Snails.....							
Squid.....					39,876		
Totals.....	303,757	24,917,213	444,540		142,485,645		
						4,012,653	6,403,583
							10,416,236

* 11,312 dozen.

* 544,342 shell oysters.

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